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Controlled Burning in Southwestern Ponderosa Pine: Results From the Blue Mountain Plots, Fort Apache Indian Reservation[1]

Edward M. Gaines, Harry R. Kallander, and Joe A. Wagner[2]

FIRE USE is a provocative topic in the present practice of forestry in the United States. After a half century of constant war against wildfires, the idea that the old enemy can be tamed, harnessed, and put to work excites the imagination. At the same time, sober logic points out that the old adage about "playing with fire," with all its implications of danger, is thoroughly and literally applicable.

Controlled and prescribed fire in American silviculture and forest protection have reached highest development in the longleaf pine forests of the Southeast. More than 20 years of research and field testing have developed principles and policies to govern use of fire there. These principles in turn provide a basis for testing fire use in other forest types and regions. Hartman (*2*) reviewed policies, principles, and dangers of fire use in the South.

Possible use of fire in ponderosa pine forests has been discussed in a series of articles by Weaver (*4, 5, 6, 7, 8, 9, 10, 11*). Kallander and others (*3*) stated that broadcast burning of a virgin area in the Southwest reduced the number and average size of wildfires. Since these presentations were based largely on observations rather than on controlled experiments, it is inevitable that the subject will remain controversial until designed tests can be carried out and evaluated. This report presents the analysis of measurements taken on the first plot study of the use of fire in the management of ponderosa pine in the Southwest.

Description of the Study

The site selected for the study is on the Fort Apache Indian Reservation near Blue Mountain 7 miles east of McNary, Arizona, along State Highway 73, in pure ponderosa pine type at an elevation of about 7,400 feet. The ground is flat, and the soil is rather heavy. The stand is uneven-aged and variable in density—small open grassy glades, dense patches of saplings and poles, and clumps of mature timber are intermixed. The area had been selectively logged in 1924. Fuels averaged more than 14 tons per acre (Table 1).

TABLE 1.—AVERAGE FUEL WEIGHTS BEFORE BURNING

Size of fuel[1]	Check plots	Plots burned in September	Plots burned in October
	Tons per acre		
Large	4.49	8.00*	3.73*
Medium	3.81	3.08	1.40
Small	6.94	6.21	4.83
Total	15.24	17.29**	9 96**

[1]Large fuel: Wood in pieces with maximum diameter 12 inches or more. Weight computed from measured cubic volume.

Medium fuel: Wood in pieces with maximum diameter 2 to 11 inches. Weight computed from measured cubic volume of samples.

Small fuel: Wood in pieces with maximum diameter less than 2 inches, plus needles, dead grass, cones, and partly rotted wood. Samples weighed after drying.

*Difference between September and October plots significant at the 5 percent level.

**Difference between September and October plots significant at the 1 percent level.

Altogether there were 12 plots, each 2.5 acres surrounded by a 66-foot isolation strip, arranged in 3 blocks of 4 plots each. Two plots in each block were chosen at random for burning; the others were retained as unburned checks. Light rain stopped the burning on September 30, when only three of the six plots had been burned (two of the most easterly block and one of the middle block). The remaining three plots were burned on October 10. As the fires were different on the two days, the original 3-block design had to be abandoned. The study as established consisted of a group of three plots that were burned on September 30, another group of three that were burned on October 10, and a group of six unburned plots.

The fuels, especially the large fuels, were substantially more abundant on plots burned September 30 than on those burned in October (Table 1).

The initial timber stands were similar on the three groups of plots (Table 2). Plots burned in October had more seedlings but fewer poles than the plots burned in September. Every plot had more young trees than are needed for adequate stand growth and development.

Forage was also quite similar on all groups of plots. Because of the relatively dense stands of trees, forage was thin (Table 3).

Weather conditions were quite different on the two days, and consequently the effects of the burns were markedly different. The plots burned on September 30 had more fuel, both fuels and the air were

[1]Based on a cooperative study conducted by the Phoenix Area, Bureau of Indian Affairs, U. S. Department of the Interior; and the Rocky Mountain Forest and Range Expt. Sta., Forest Service, U. S. Department of Agriculture, with central headquarters at Colorado State University, Fort Collins, Colo. The study was planned and initiated by Harold Weaver, now area forester for the Bureau of Indian Affairs at Portland, Ore., and George S. Meagher, now with the Pacific Northwest Forest and Range Expt. Sta. of the U. S. Forest Service.

[2]Forester, Rocky Mountain Forest and Range Experiment Station, Flagstaff, Ariz.; forest manager, Fort Apache Indian Reservation, Whiteriver, Ariz.; and range conservationist, Bureau of Indian Affairs, Washington, D. C., respectively.

TABLE 2.—TIMBER STANDS BEFORE BURNING

Tree size class	Check plots	Plots burned in September	Plots burned in October
	Number of stems per acre		
Seedlings (less than 1 ft. tall)	615	229**	800**
Saplings (1 ft. tall to 3 in. d.b.h.)	4,432	4,855	3,292
Poles (4 to 11 in. d.b.h.)	279	363**	252**
Sawtimber (12 in. and larger d.b.h.)	24	23	21
Total	5,350	5,470	4,365
	M board feet per acre, Scribner Decimal C		
Volume of sawtimber	8	7	6

**Difference between September and October plots significant at the 1 percent level.

TABLE 3.—GRASS DENSITIES AND NUMBER OF PLANTS PER 100-FOOT LINE TRANSECT, BEFORE BURNING

Treatment	Plants per 100 foot line transect	Density
	Number	*Percent*
Check plots	14.63	1.38
Plots burned in September	11.03	1.02
Plots burned in October	15.45	1.54

more moist. The air was cooler and winds were stronger and steadier than for the October burn (Table 4). As strong winds dissipate heat above flames, all four of the measured weather factors operated to maintain cooler temperatures in the tree crowns during the September burn. A light shower that fell while the fire was burning, and a rain the following night may have affected the volume of larger fuels consumed.

The difference in the effects of the two fires forced a change in procedure for analyzing results. Date of burning became confounded with geographic location (east *vs.* west plots) and destroyed the validity of the randomized-block design. Furthermore, the differences in effects of the fires assumed greater importance than the differences between burned and unburned. The effects of the fires on the two dates were therefore compared by using standard procedures for testing significance of differences. Covariance was used in some analyses to compensate in part for difference in location. But the three plots for each treatment is, at best, a weak basis for statistical testing. Furthermore, there was great variation between plots that were treated alike. Consequently, some large differences between treatments could not be demonstrated to be significant statistically.

Effects of Burning

Fire effects were evaluated in terms of fuel reduction, damage and benefits to the existing timber stand, and effects on forage. No attempt was made to determine effects on site, erosion, water relationships, establishment and survival of new tree seedlings, or wildlife habitat. Effects of fire on forest soils in the region where the study was made have been discussed by Fuller and others (*1*).

Effects on fuels.—Preburn fuel inventories were made during June, July, and August 1950; and postburn inventories, in December 1950. All large fuel was measured, and medium and small fuels were sampled. Fuel weights before and after burning are summarized in Table 5. Definitions of fuel sizes, and methods of determining fuel weights, are given in a footnote to Table 1.

Burning reduced fuels appreciably. A factor not fully anticipated, however, was that trees and needles killed but not consumed by the fire added to fuel immediately and thereby partially offset consumption of previous fuels.

Fuel lying on the ground is a greater immediate hazard than fuel in standing dead trees. The two burns were about equally effective in reducing ground-level fuels; the good cleanup of heavy fuel in the October burn was partially offset by an actual increase of medium fuel.

There was a large increase in the amount of standing dead fuel following the October burn, but a definite decrease on the September burn. However, variance between plots treated alike is so great that differences between the two burns are apparently significant statistically only for medium fuel. Standing fuels are less hazardous than those on the ground, but eventually they fall and become ground-level fuel.

Large fire-killed trees increase the number of snags (Table 6). The contrast in number of snags (more on the October burn and fewer on the September) is apparently a real difference, even though the difference in volumes of the same material, as shown in Table 5, was not significant statistically.

Data show clearly that the September burn was considerably more effective than the one in October in reducing total fuel (standing plus ground level). The September burn was also much more uniform in its effects on fuels. In several comparisons, the variances of October-burned plots were considerably larger than those of September-burned plots. The variable effect of the October fire is further emphasized by the big increase in

TABLE 4.—FIRE WEATHER CONDITIONS[1] ON THE TWO DAYS OF CONTROLLED BURNING BLUE MOUNTAIN PLOTS, FORT APACHE INDIAN RESERVATION

Burning conditions	September 30, 1950	October 10, 1950
Hours of burning	10:00 a.m.-3:40 p.m.	12 noon-3:30 p.m.
Air temperature	59° F.-67° F.	73° F.-75° F.
Relative humidity (air)	62%-37%	19%-17%
Fuel moisture	14.0%-11.6%	10.0%-8.5%
Wind velocity	18-25 m.p.h.	3-12 m.p.h.
Remarks	Light shower during burn of last 2 plots; 0.25" rain fell at McNary after 6 p.m.	Wind variable and gusty; spot "blowups" during burning

[1]Observations made at the plots.

medium fuel and the decrease of large and small fuel, as contrasted with decrease of all fuel sizes on plots burned in September. The greater uniformity of the September burn is important, for uniformity of results is an objective in any fire use.

Both fires raised the lower level of tree crowns in sapling thickets by killing seedlings and small understory saplings and by killing the lower green limbs of dominant saplings. Dead needles and some dead twigs within 2 to 4 feet of the ground were consumed. It is possible that sapling thickets would not "crown out" so readily or burn so intensely on the burned plots as on the unburned.

Effect on timber stand.--Many seedlings and saplings and a few larger trees were killed by the burning. The October burn killed a greater proportion of trees than did the September burn (Table 7); it even killed 6 percent of the merchantable timber volume.

Practically all seedlings were killed on both burns; few trees less than 3 or 4 feet high survived.

On each date, damage on individual plots was in direct proportion to weight of fuel on them. Covariance analysis was therefore tried. Weight of fuel was used as the independent variable; and percent kill, as the dependent. The correlation between fuel weight and percentage of saplings and poles killed (sizes kept separate in the analysis) was significant at the 5 percent level, and fuel weight accounted for 52 percent of variance within burning dates. Difference between the two burns showed significance in both sapling and pole classes.

First study of Table 7 might suggest that the October burn had done a reasonably good job of thinning; whereas the September burn had not been drastic enough. However, effectiveness of thinning cannot be evaluated on acre averages alone; the distribution of remaining trees is of greater importance. Furthermore, a stand has not been effectively thinned, in the silvicultural sense, unless certain promising trees (often referred to as "crop trees") have been released sufficiently to maintain or increase their growth rate.

A special survey was made in September 1952 to determine the effectiveness of the burns in thinning and the extent to which they eliminated or damaged needed crop trees. Burned areas were classified as to the proportion affected in different ways, as follows:

1. Area effectively thinned by fire;
2. Area fire damaged, where the "crop trees" were so severely scorched as to affect their development, or where the remaining crop trees are inferior to some that were fire killed;
3. Area fire killed, where all available crop trees were fire killed;
4. Area where crop trees were unaffected by fire;
5. Area unstocked prior to fire and therefore unaffected.

The September burn had little silvicultural effect on the stand (Table 8). The 3,300 stems per acre killed were mainly in the suppressed understory. The October burn, on the other hand, did some effective thinning in pole and sapling stands, but this benefit was

TABLE 5.—EFFECT OF CONTROLLED FIRE ON FUEL WEIGHTS

Size and position of fuel	Weight of fuel					
	September burn			October burn		
	Before	After	Change	Before	After	Change
	Tons per acre		*Percent*	*Tons per acre*		*Percent*
Ground-level fuel:						
Large	6.37	2.35	−63*	3.48	0.91	−74*
Medium	3.08	1.17	−62*	1.40	2.56	+83*
Small	6.21	3.25	−48	4.83	2.35	−51
Subtotal	15.66	6.77	−57	9.71	5.82	−40
Standing fuel (in dead trees):						
Large	1.63	.45	−72	.25	1.11	+344
Medium	0	.26*	—	0	1.57*	—
Subtotal	1.63	.71	−56	.25	2.68	+972
All fuel, ground plus standing:						
Large	8.00	2.80	−65	3.73	2.02	−46
Medium	3.08	1.43	−54**	1.40	4.13	+195**
Small	6.21	3.25	−48	4.83	2.35	−51
Total	17.29	7.48	−57**	9.96	8.50	−15**

*Difference between September and October burns significant at 5 percent level.
**Difference significant at 1 percent level.

TABLE 6.—EFFECT OF CONTROLLED FIRE ON NUMBER OF SNAGS

Time of burning	Snags[1] per acre		
	Before burn	After burn	Change
September	2.5	1.1	−1.4
October	.4	1.1	+ .7**

[1]Standing dead trees at least 12 inches in diameter and at last 6 feet tall.
**Difference between September and October burns significant at 1 percent level.

TABLE 7.—EFFECT OF CONTROLLED FIRE ON TIMBER STAND

Tree size class	Trees per acre					
	September burn			October burn		
	Before	After	Reduction	Before	After	Reduction
	Number		*Percent*	*Number*		*Percent*
Seedlings	229	4	98	800	8	99
Saplings	4,855	1,776	63**	3,292	775	76**
Poles	363	351	3**	252	186	26**
Sawtimber	23	23	0	21	20	5
Total	5,470	2,154	61**	4,365	989	77**
	Bd. ft. per acre			Bd. ft. per acre		
Volume of sawtimber	7,003	7,003	0	6,013	5,679	6

**Difference between September and October burns significant at 1 percent level.

TABLE 8.—EFFECT OF CONTROLLED BURNING ON STOCKING OF PONDEROSA PINE BY BROAD STAND CLASSES, MEASURED 2 YEARS AFTER BURNING

Stand class	Effect of burning	Stocking			
		Total area		Stand class	
		Sept. burn	Oct. burn	Sept. burn[5]	Oct. burn[5]
		Percent			
Unstocked (before burning)		10	7	—	—
Sawtimber[1]		28	27	—	—
	Killed			0	7
	Damaged			3	7
	Unaffected			97	86
				100	100
Pole and sapling[2]		62	66		
	Killed			3[4]	25[4]
	Damaged			0[3]	9[3]
	Unaffected			94[3]	54[3]
	Effectively thinned			3	12
Total		100	100	100	100

[1]Sawtimber class includes mature stands with no understory and immature sawtimber stands with or without understory.
[2]Pole and sapling stands include stands that have a mature sawtimber overstory.
[3]Difference between September and October burns significant at 5 percent level.
[4]Difference between burns significant at 1 percent level.
[5]Total difference between burns significant at 1 percent level.

more than offset by the area on which needed crop trees were either damaged or completely killed.

Much of the area classed as effectively thinned was in the zone between areas completely killed and areas still overstocked. Released trees in these fringe areas will tend to grow limby on one side unless they are pruned as they develop.

Thus the hoped-for thinning effects were not promising. Apparently, the range of intensity within which fire will thin effectively is too narrow to be attained consistently with the degree of control over fire that we now have.

Effect on grass.—Grass was first inventoried in September 1950 just before burning, with followup surveys in September 1951 and September 1952. Unburned check plots were inventoried each time to provide control. Grass density on the Blue Mountain plots was low before burning, largely because the tree stands were so heavy. It was declining annually on the unburned plots because of continuous drouth.

Both burns reduced grass density the first year after burning (Table 9). The September burn recovered after two years, but the October burn did not. The trend in number of plants gives a clue as to why. The September burning had little immediate effect on plant numbers, and two years after the burn the September plots showed a greater increase in plant numbers than did the check area. The October burn reduced the number of plants the first year, and recovery the second year was less than on the other burn.

Some changes in species composition resulted from burning. The proportional density of mountain muhly (*Muhlenbergia montana*) dropped from about 70 percent of the total grass density before burning to about 60 percent two years later on both burns. There was a four- to fivefold increase in proportional density of squirreltail (*Sitanion hystrix*) on both burns. Change in proportional numbers of plants of the two species was less drastic and of questionable importance.

TABLE 9.—RELATIVE EFFECT OF CONTROLLED FIRES ON GRASS FOR TWO YEARS AFTER BURNING

Year[1]	Density			Plants per 100-foot transect		
	Sept. burn	Oct. burn	Unburned	Sept. burn	Oct. burn	Unburned
	Percent			*Number*		
1950	1.024	1.537	1.383	11.03	15.45	14.63
1951	.450	.485	1.015	9.46	9.05	12.75
1952	.736	.543	.983	13.50	12.23	14.94

[1]1950 measurements before burning. 1951 and 1952 measurements at end of growing season.

Discussion of Results

The Blue Mountain test fires show that fuels can be reduced by fire. What the fuel reductions may save in fire-control costs and wildfire damages is yet to be learned. The topic is beyond the scope of this study, but a few general comments are in order.

Controlled fire will reduce fuel only temporarily in the southwestern ponderosa pine type. Fuel starts building up again as needles and dead grass accumulate and as trees die. Snags that were burned down and old resinous wood that was consumed will be much more slowly replaced. Fuel accumulation is progressive and it will be difficult to select a point where the reduction ceases to be effective.

Can burning to reduce fuel be done within acceptable limits of damage to living trees? It is obvious that the October fire destroyed or damaged an excessive area of the stands: 34 percent of young stands and 14 percent of sawtimber stands. The limited damage on the September burn may be tolerable. Evaluation would involve cost and benefits of burning as well as damage and is beyond the scope of this study.

The September fire may have been near the ideal in the sense that damage was near an irreducible minimum, considering the amount of fuel that was destroyed. But the weather conditions during the fire were rather unusual and of short duration, and there is no indication that large areas can be burned with so little damage. Large-scale burning was done on the Fort Apache Reservation in the late fall of 1950 and 1954,

years when dry weather extended to the last of December. A limited survey of the 1954 burn showed that damage to living stands was greater than that of the September 30, 1950 burn on the Blue Mountain plots. Evidently controlled burning will have to be an opportunistic job until precise measures or limitations of adequate burning weather can be worked out.

Summary and Conclusions

A small plot test of controlled burning in ponderosa pine near McNary, Arizona, on the Fort Apache Indian Reservation led to the following conclusions:

1. Fire, if properly controlled, may reduce fuels in ponderosa pine stands without excessive damage to trees larger than sapling size.

2. Fires hot enough to kill large living trees increase rather than decrease total fuel—ground plus standing.

3. Appreciable effective thinning was accomplished only on the burn of October 10, but this was more than offset by the area where the young stand was damaged or completely killed.

4. Few seedlings less than 3 or 4 feet tall survived on either burned area.

5. On the basis of plot averages for two years, which are not adequate for drawing final conclusions, grass density was reduced for only one year following the September 30 burn. Density still was reduced after two years on the October 10 burn where timber stands were damaged more severely.

6. Damage to timber stands was probably near the irreducible minimum on the September 30 burn, because of very favorable weather conditions.

Although this study indicates that controlled fire may be useful in reducing fuel in ponderosa pine in the Southwest, it points up the need for more information both on the conditions under which it is feasible, and on techniques for its proper use.

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Addition to Directory of Consulting Foresters

The following listing was inadvertently omitted from the Directory of Consulting Foresters, published in the January JOURNAL OF FORESTRY:

Vernon A. Good, Consulting Forester, American Bank Building, Portland, Oregon.

Territory: Oregon, Washington, Idaho, Northern California.

Specialization: Cost and economic studies of forest operations; forest management and silvicultural practice; forest taxation; pulpwood operations; range management; timber volume and quality estimates; tree planting and reforestation; reproduction studies; forest property management; timber marking; sales contracts and supervision; acquisition; aerial photo inventory; fire damage appraisals; timber tax assistance; also watershed and land use management.

A Method of Evaluating Site Quality in Young Red Pine Plantations

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THERE ARE NOW some 5 million acres of forest plantations in the United States, according to the recent Timber Resource Review,[1] and an additional 50 million acres of land in need of planting. This large acreage, present and potential, of man-made forests calls for special methods of management. Among the urgent needs are reasonably accurate ways of estimating site quality. Quantitative estimates, even when approximate or limited in scope, are useful in evaluating success of existing plantations, prescribing appropriate management, and rating species and sites as guides for subsequent planting in nearby areas.

For a variety of reasons, conventional site index methods frequently are not adapted to young plantations. With introduced species, the number of existing older plantations is often too few for construction of site index curves based on age 50. Curves for native species commonly are derived from natural stands and often fail to describe the height-age characteristics of young plantations on old fields or sites long out of forest. Site index curves may be prepared expressly for plantations (e.g., *2*), but few are available. Moreover, variability in the establishment period is a major source of error in applying any classification based on total age to young plantations. And even though total height provides a satisfactory index, there are practical difficulties in measuring it rapidly and accurately in tightly closed young plantations.

Considerations such as these led Wakeley in 1937 to propose a "growth intercept" index based on height growth during the 5-year period that begins with the year in which the breast height level is attained. This growth intercept index remained known chiefly to Wakeley's associates until reported in 1954 (*7, 10*). The senior author of the present paper hit upon essentially the same measure in 1951 while conducting surveys in young plantations.[2] Subsequently Warrack and Frazer (*9*) have reported that the 5-year growth intercept is closely related to the site index actually attained by second growth Douglas-fir. In addition, Husch (*4*) and McCormack (*5*), among others, indicate that age above breast height is preferable to total age as the variable in height-age curves in order to reduce the irregularities of the establishment period.

The present paper demonstrates that in young red pine (*Pinus resinosa* Ait.) plantations height growth of dominant and codominant trees for the 5-year period above breast height can be a reliable indicator of growth in the next 15 to 20 years. The basis for the relationship is evident from site index curves which imply that, in principle, the differences between site classes exist from a very early age onward. Confining growth measurements to the portion of the stem above breast height greatly reduces the effect of irregularities during the establishment period.

Our results, as well as those of Bull (*2*) and McCormack (*5*), indicate that height growth of red pine is at, or near, its maximum rate during this 5-year period so that differences are soon expressed. The difference between Wakeley's index, beginning with the annual node immediately below breast height, and ours, beginning with that above breast height, ordinarily is slight. The establishment period of red pine on adverse sites is occasionally prolonged to breast height, however, though only rarely above this point.

Basic Data

The basic data were obtained in 1953 and 1955 from sample plots in 39 red pine plantations, ranging from 13 to 32 years in age. Approximately half the plots were from the oldest plantations available in central New York State; the remainder were chiefly located on the sandy outwash soils surrounding the Adirondack Mountains of New York. These plots represent nearly the maximum range of site qualities, with the lowest sites being markedly inferior to those studied by other authors (*2, 5*).

In each plot total height, total age, and age at breast height were determined on nine dominant and codominant trees chosen at random. Only obviously deformed or injured trees were rejected. Height growth for successive 5-year periods, beginning with the first node above breast height, was obtained by climbing or use of a measuring pole.

[1] U. S. Forest Service. Timber Resource Review. Chapter IV-C. 1955.

[2] Ferree, M. J. Comparison of close-spaced and wide-spaced plantations. Unpublished report presented at the 1952 summer meeting of New York Section, Society of American Foresters. College of Forestry, State University of New York, Syracuse, N. Y. 1952.

Analysis

Influence of the establishment period.—The average time for sample trees of each plot to reach breast height was plotted against height growth during the subsequent 5-year period, or growth intercept. Figure 1 presents the results.

From 4 to 13 years after planting were required to reach the breast height level. The slope of the curve and the weak correlation coefficient indicate that the site conditions determining growth above breast height exert only a small influence upon establishment time. Factors such as planting stock quality, planting technique, competition, surface soil characteristics, and frost or animal injury presumably exert a much larger influence. It is evident that inclusion of height-age data from below 4½ feet would inject a large and unrelated variation into site index calculations.

A further reason for restricting measurement to portions of the tree above breast height is the difficulty in determining total age when planting date is not known. The number of annual nodes below breast height cannot be counted accurately, and the usual counts on increment cores are scarcely better.

Construction of site index curves.—Site index curves were constructed according to the general procedure of Bruce and Schumacher (*1*), but using the age and height measurements that begin with the first node above breast height. For each plot, average height growth was computed by consecutive 5-year periods above this point. The plantations were then stratified into 1-foot height growth classes according to growth in the first 5-year period. Data from plantations within each class were pooled and average heights for each class calculated by 5-year intervals above breast height. Height-age curves were then prepared and harmonized to smooth out minor irregularities. The final family of curves was prepared by interpolation to define growth intercept

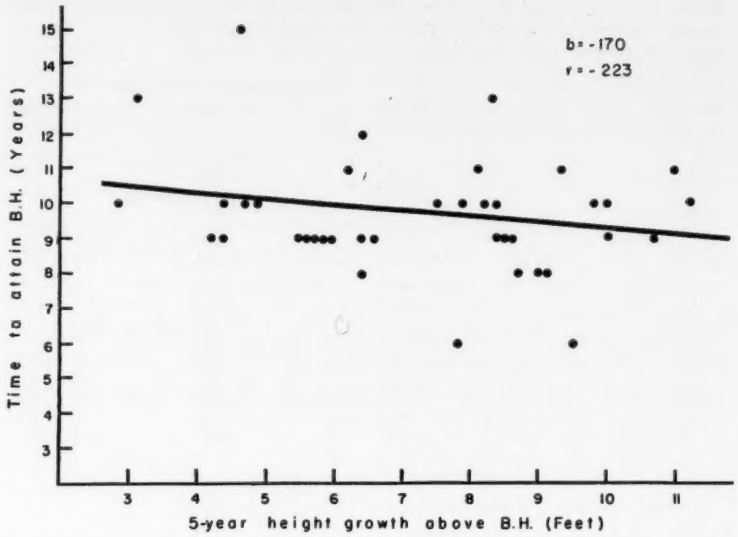

FIG. 1.—Relationship between 5-year height growth above breast height, and time to attain breast height.

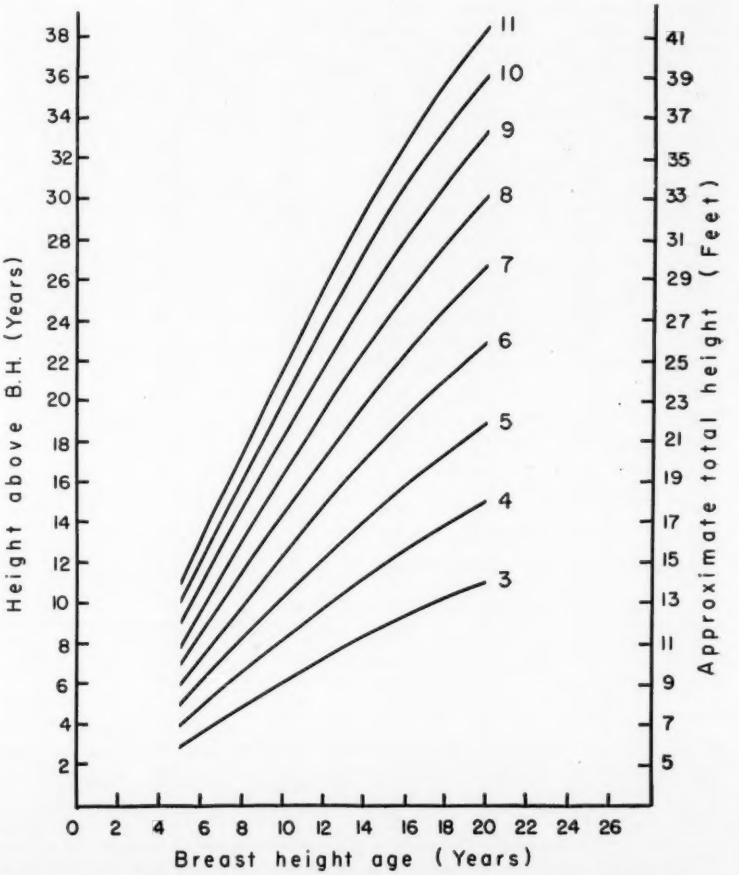

FIG. 2.—Site index for young red pine plantations, based on 5-year intercept.

TABLE 1.—DEVIATION OF FIVE-YEAR INTERCEPT ESTIMATE OF TOTAL STAND HEIGHT FROM BULL'S (*2*) PREDICTED VALUES

Five-year intercept site index[1]	Age above breast height 10 years	15 years	20 years
	Deviations in feet		
4.5	+0.5	−0.6	−0.9
5.2	−0.2	−1.3	−1.6
5.7	+0.3	−1.1	−2.0
6.0	+0.5	−0.8	−2.0
6.6	+0.1	−0.9	−1.6
7.2	0	−0.6	−1.4
7.8	−0.3	−0.3	−0.8
7.9	+0.2	0	−0.8
8.5	+0.4	+0.3	−0.5
9.2	+0.5	+0.9	0
9.9	+0.7	+1.4	+0.5
10.2	+0.3	+1.4	0
10.3	+0.2	+1.2	+0.1
10.8	+0.4	+1.2	+0.1
11.5	+0.5	+1.1	+0.3

[1]Bull's site indexes were adjusted to make comparison possible.

TABLE 2.—TOTAL HEIGHTS ESTIMATED FROM INTERCEPT INDEX CURVES (FIGURE 2) COMPARED WITH ACTUAL HEIGHTS, FOR 37 RED PINE PLANTATIONS IN CENTRAL NEW YORK

Plot no.	Mean age above breast height	5-year intercept site index	Total height Actual	Total height Estimated	Difference, est.-act.	Difference as percent of total height
	Years		*Feet*		*Feet*	*Percent*
A.						
12	8.0	9.8	20.2	20.7	+ 0.5	+ 2.8
11	10.8	10.3	25.0	27.1	+ 2.1	+ 8.4
21	11.5	10.3	27.7	28.5	+ 0.8	+ 2.9
1	13.3	9.0	29.0	28.9	− 0.1	− .3
39	13.5	11.2	33.0	34.2	+ 1.2	+ 3.6
B2[1]	13.6	7.1	26.3	24.5	− 1.8	− 6.8
38	13.8	8.8	31.0	29.4	− 1.6	− 5.2
19	14.2	9.7	30.3	32.0	+ 1.7	+ 5.6
22	14.5	8.8	30.7	30.3	− 0.4	− 1.3
B6	15.0	7.9	28.7	28.8	+ 0.1	+ .3
5	15.3	8.9	31.8	31.8	0	0
B5	16.0	8.0	28.9	30.4	+ 1.5	+ 5.2
B8	16.0	6.6	27.2	27.1	− 0.1	− .4
30	16.2	5.9	27.5	24.1	− 3.4	−12.3
4	16.3	9.8	36.8	35.6	− 1.2	− 3.3
23	16.7	8.4	31.7	32.4	+ 0.7	+ 2.2
26	16.8	9.8	38.8	36.6	− 2.2	− 5.7
B1	17.0	10.0	38.2	37.3	− 0.9	− 2.3
B4	17.0	2.7	14.1	14.0	− 0.1	− .7
7	17.0	11.0	37.5	39.5	+ 2.0	+ 5.3
31	17.2	7.2	30.5	29.4	− 1.1	− 3.6
47	17.2	9.3	35.5	35.8	+ 0.3	+ .8
25	17.3	8.5	34.0	33.5	− 0.5	− 1.5
33	17.5	7.3	30.5	30.2	− 0.3	− 1.0
6	17.5	10.9	38.0	39.8	+ 1.8	+ 4.7
17	17.8	9.0	36.3	35.6	− 0.7	− 1.9
B3	18.0	10.7	42.2	40.3	− 1.9	− 4.5
34	18.0	8.5	34.2	34.6	+ 0.4	+ 1.2
36	19.2	9.0	36.0	37.5	+ 1.5	+ 4.2
43	19.3	9.5	39.5	39.0	− 0.5	− 1.3
35	19.7	9.8	39.0	40.2	+ 1.2	+ 3.1
3	20.7	9.5	40.8	40.5	− 0.3	− .7
44	20.7	11.4	47.2	45.3	− 1.9	− 4.0
B.			Mean difference:		−0.1±2.6	
28	15.3	5.3	23.8	21.2	− 2.6	−10.9
32	16.7	7.0	25.0	26.9	+ 1.9	+ 7.6
37	18.0	9.2	26.3	36.5	+10.2	+38.8
41	24.3	9.3	39.0	43.9	+ 4.9	+12.5

[1]Information on plantations having a prefix of "B" provided by Onondaga County Park System.

classes separated by 1 foot intervals at the classification age of 5 years above breast height.

These curves are presented in Figure 2. The individual curves have slightly different shapes, indicating that the progress of height growth does not have the same characteristics on all sites. Nevertheless, deviations from a straight line relationship are very slight, in best and poorest classes alike, until a breast height age of 12 to 14 years is reached. On the average the beginning node falls appreciably above 4.5 feet and Bull's data indicate that 5.0 feet can be taken as the mean origin of these curves.

Reliability of Estimates

Three independent tests were made to determine how reliable total stand height could be estimated from the intercept index curves of Figure 2.

For the first test the actual stand heights of the basic plots were compared with values estimated from their growth intercept indexes. At an age of 10 years above breast height—5 years beyond the intercept age—two -thirds of the estimates were within 5 percent of the true values, and at 15 and 20 years above breast height, within 6 and 9 percent, respectively.

The site index curves for young red pine plantations in Connecticut (*2*), were utilized for the second test. The 5-year growth above breast height read from Bull's curves was applied to Figure 2 of the present paper to estimate height at subsequent ages. In Table 1 these estimates are compared with the values given by Bull.

The absolute deviations are seen to be small. Thus, when the growth period below breast height is ignored, Bull's curves yield approximately the same values as Figure 1.

The third and most significant test was a comparison of actual height with height estimated from intercept index for an additional sample of 37 red pine plantations. These plantations were located within a radius of 40 miles of Ithaca, New York, on soils vary-

ing in drainage class from well to somewhat poorly drained. Details of the comparison are given in Table 2.

A summary of Section A, comprising 33 plantations, demonstrates that the intercept index method can estimate apparent site quality with considerable reliability, at least to ages of 20 years beyond breast height. The largest deviation —12.3 percent, occurs in a plantation on shallow soil. In this instance penetration of roots into the fractured bedrock has allowed better development than the intercept index, i.e., early growth, promised. Of the other plots, only two exceed an error of 6 percent of true value, and the absolute deviations seldom exceed 2 feet. The deviations reveal no bias related to age or site class and there is no trend toward increasing percentage errors with greater stand age, as found in the two former tests. Further, magnitude of the percentage errors is not related to site class; large and small errors occur in the best and poorest stands alike.

Section B of Table 2 presents data for the remaining plantations of the sample group. All occur on somewhat poorly drained soils and have been affected by a "site disease" associated with impeded drainage (*6*). These illustrate circumstances in which growth rates can not properly be extrapolated, by this or any other form of site index prediction. In plot No. 28 earlier mortality has greatly reduced stocking of red pine and the trees remaining to be measured are the fortunate individuals located on small mounds elevated 6 to 12 inches above the general surface. Plots Nos. 32, 37, and 41 now show visible disturbances of foliage and growth, though the growth deviations began somewhat earlier.

Moreover, it is probable that some plots on similar soils now included in Section A will be similarly affected eventually. Section B emphasizes that no form of growth prediction substitutes for adequate knowledge of site relationships; such knowledge is, in fact, essential for satisfactory forecasts with any index. One of the values in making growth estimates by the intercept index method, however, is that deviations due either to growth disturbances or changes in "current site index" (*3*) can be more quickly recognized and evaluated.

Application

When thus qualified, the 5-year intercept index method is a satisfactory means of evaluating growth in young red pine plantations. The growth estimates are as accurate as may reasonably be expected. It is easy to apply, in terms of the time and skill required. It is independent of effects of variations in stocking and is equally applicable to stands of various ages.

The purpose of the site index appraisal governs the intensity with which the method would be applied. Three or four site quality classes would probably suffice for most forest inventory work;[3] more detailed studies might well require finer divisions. In any case the data must be taken in sufficient detail to permit establishing the required number of quality classes.

The suggested mechanics of applying this system in plantations are as follows: The plantation to be sampled is first subdivided according to any obvious differences in total height or probable site quality. Within each subdivision the 5-year height intercept is measured on randomly selected dominant and codominant trees that are free from damage within the intercept period. A graduated pole with a hook at one end is convenient for this purpose. Some uses will require a mean intercept value having an error less than 5 percent, at odds of 95 out of 100, for each subdivision. The variance encountered in our data indicates that measurement of about nine trees ordinarily will provide this accuracy in sample plots. Large variation among trees will require more measurements; lower standards of accuracy, fewer.

Application implies certain obvious precautions. Figure 2 should be used with discretion in areas outside New York State. Extrapolation of these curves to ages older than shown is not advised, unless appropriate data are obtained. The relationships of Figure 2 or similar curves can be distorted by tree damage within the intercept period, by significant changes in site conditions as the plantation develops and, as illustrated, by various maladies. Such influences likewise distort conventional site index methods. Ordinarily, intercept index curves would be used only until plantations were old enough, or values great enough, to justify construction of conventional indexes.

Application to Other Species

Preliminary results indicate that this method is also a satisfactory means of classifying white pine, Norway spruce, and Scotch pine plantations. A study of 18 plantations of each of these species demonstrated that age-height development above breast height is closely related to the respective 5-year intercept growth. The form of the relationship differs for each species and none resemble that of red pine. Standard errors of estimate for the plotted curves indicate greatest precision for those of red pine, followed by Scotch pine, Norway spruce, and white pine in that order. With the latter two species, white pine weevil often seriously affects total height. Growth intercept or an analogous measure applied to unweeviled portions of the stem should provide a better index of growth potential in young plantations.

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Five-Year Intercept as Site Index in Southern Pine Plantations

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THE TOTAL HEIGHT-TOTAL AGE relationship widely accepted as an index to site in stands more than 25 years old (*7*) has theoretical and practical limitations as a site index in plantations below 15 or 20 years of age. As an alternative in young coniferous plantations, the senior author, in 1937, proposed using the increase in height during a 5-year period after the planted trees were well established. In 1946, in the course of graduate study at the University of Michigan, the junior author tested such a "5-year intercept" in southern pine plantations of four species. This report is designed to make the underlying concept and the 1946 findings generally available, and particularly to describe the application of the method to the multinodal southern pines.[1]

Shortcomings of Site Indices Derived from Total Height

Although the total height-total age relationship is less affected by stand density than is the diameter-age or volume-age relationship, and has been found a useful index to site in older stands, it suffers from several disadvantages in stands less than 15 or 20 years old.

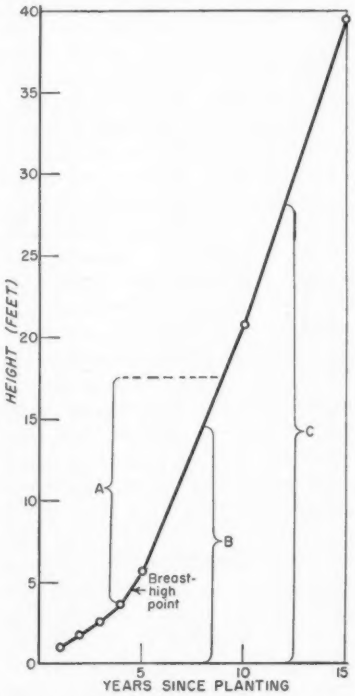

FIG. 1.—Curve of height over age of an uninjured slash pine tree, from measurements made 1, 2, 3, 4, 5, 10, and 15 years after planting. *A* shows schematically the uniform annual height increments included in the 5-year intercept; *B* and *C*, the nonuniform increments included in total heights 8 and 12 years after planting.

These disadvantages tend to be accentuated in young plantations.

1. Without individual-species curves of the type presented currently by Ferree and coworkers for red pine (*3*), the sites in two plantations of a given species cannot be compared on the basis of average total height unless the plantations are of identical age.

2. In young plantations, average annual height growth for the entire ages of the trees is likewise unsuitable for comparing sites unless the plantations are identical in age. In two plantations of different ages, the average annual height growth of the older ordinarily is increased by inclusion of more years of growth at the maximum possible rate, which usually is attained shortly after a period of slow growth associated with initial establishment (Fig. 1, *B* and *C*).

3. The younger the stand, the more seriously an index involving total height is affected by any misconception concerning the age of the stand. An error of a year in determining the age of a stand about 50 years old may throw the site index off 1 or 2 percent. Calling a 10-year-old plantation either 9 or 11 years old introduces an error of about 10 percent. Plantation records are not infrequently

[1]The authors are indebted to the School of Forestry and Conservation, University of Michigan, for making possible a field test of the technique, and to M. J. Ferree, E. L. Stone, Jr., and T. Shearer for the opportunity to submit this paper for publication simultaneously with (*8*).

misdated by a year; more often, they are unobtainable and cannot be reconstructed by physical evidence in the field.

4. Rabbit, tip-moth, brown-spot, and similar injuries exert their effects partly, and in most cases entirely, before the trees reach breast height. The same is true of wrong choice of size, grade, or class of nursery stock, mishandling of stock in transit, and lapses in planting technique. All these adverse influences are largely and in most instances wholly independent of any innate quality of the site. Their effects upon the site index should be kept at a minimum, but are likely to be at a maximum if the total height-total age relationship is used as an index in young stands.

5. Total heights exceeding 25 or 30 feet are relatively difficult to measure in closely spaced plantations in which survival is good.

Some of these disadvantages of site indices derived from total height, together with others not mentioned here, are listed in (*3*).

The Five-Year Intercept

Averaging the height growth made during a period of unhindered and relatively uniform development (Fig. 1, *A*), rather than that made during the entire life of the planted tree (Fig. 1, *B* or *C*), seemed a logical way to avoid the difficulties just described. Measuring the portion of the stem intercepted by the beginning and end of five years' growth (Fig. 1, *A*) led naturally to the term "5-year intercept index."

The period of five years was chosen as long enough to average out ordinary annual variations in weather conditions affecting growth, yet short enough to be used in relatively young plantations and to permit economical measurements regardless of total age.

The 5-year period was defined in terms of the development of each individual tree measured, rather than in calendar years. In the study reported here, it was taken as the 5-year period during the first year of which the tree attained breast height[2] (Figs. 1 and 2).

Use of the intercept index involves two assumptions: (1) that the height growth made by each tree each year for the five years beginning with attainment of breast height can be determined correctly; and (2) that once trees of a given species and at a wide range of plantation spacings have reached breast height on comparable sites, they will grow at essentially comparable rates for the next five years or more, whereas on contrasting sites they will grow at consistently contrasting rates. Within the limits of these assumptions, the intercept index appears to be free from all the disadvantages detailed in connection with indices based on total height.

The most obvious advantage of the intercept method in practice is that no determinations of age are necessary, either from records or by field observation.

[2]Ferree and coworkers (*3*) start their 5-year intercept with the first annual height increment *above* breast height. Which of the two starting points is chosen probably is unimportant, though with the fast-growing southern pines, in which 5-year intercepts may be more than 20 feet long, the lower starting point makes measurement easier.

Test of the Five-Year Intercept in 1946

Most of the data for testing the 5-year intercept were taken by the junior author and G. W. Abel in 19 loblolly (*Pinus taeda* L.), 6 slash (*P. elliottii* Engelm.), and 3 shortleaf pine (*P. echinata* Mill.) plantations studied by Abel in a survey of forest plantations and plantation soils made in northern Mississippi in 1946 in cooperation with Mississippi State College. Three longleaf pine (*P. palustris* Mill.) plantations were measured jointly by both authors at Bogalusa, Louisiana, in September 1946. All data were analyzed by the junior author.

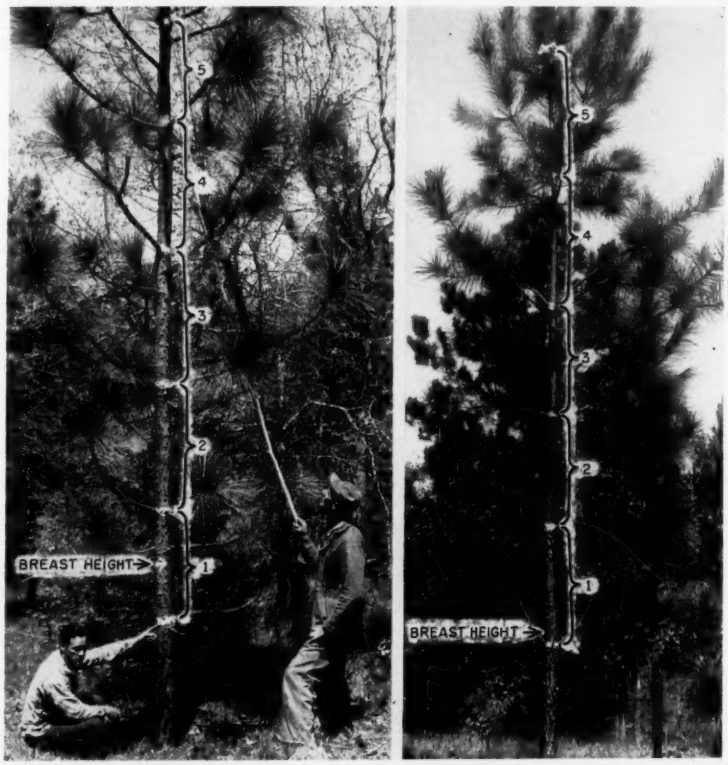

FIG. 2.—*Left*, longleaf pine, and *right*, loblolly pine, with the successive annual height increments of the 5-year intercepts marked in white.

Measurements were made in small plantations on relatively uniform sites, or in uniform subdivisions of larger plantations on variable sites. As a rule, each sample in each plantation or subdivision consisted of 25 trees; in a few instances, only 15 were measured. Generally, two samples were taken in each plot, the first consisting of trees regardless of crown class or potential crown class, and the second of the dominant and codominant trees of the first sample, plus enough additional dominants and codominants to bring the total of these classes to 25. Ordinarily, sampling consisted of measuring every eighth or tenth tree encountered, exclusive of those obviously injured or otherwise abnormal. Total heights were measured with an Abney level and intercepts with a steel tape attached to an extension rod. Pertinent soils data and descriptive notes were taken with each sample.

Problem of the Multinodal Habit of Growth

The first question to be answered in testing the 5-year intercept was whether successive annual height increments above the breast-high point of the southern pines could be identified with certainty in the field.

Except for those of the first few years, such annual height increments are easily identified in young specimens of the northern and western pines that form one internode and one whorl of branches each year. Internode counts had long ago been used in studies of such species by Baldwin (*1*), Brewster (*2*), Pearson (*4*), and others. The southern pines, however, are multinodal (*6*), and produce variable numbers of internodes and branch whorls per year (*5*). Furthermore, height growth and branching habit of loblolly and shortleaf pines are frequently modified, even above breast height, by attacks of Nantucket tip moth (*Rhyacionia frustrana* Comst.).

It had been common knowledge for many years that the beginning of any one year's height growth in any of the southern pines, and particularly of longleaf and slash pines, could be recognized by a particularly long internode, assumed to form as a result of overwinter elaboration and storage of carbohydrates (Figs. 2 and 3). In some specimens of these species, however, and in a higher proportion of loblolly and shortleaf pines, the second internode of the year may be as long as or longer than the first.

The 1946 study brought to light further means of identifying the beginning of a year's growth. First, regardless of whether the annual height increment comprised three, four, or more internodes (the authors have recorded as many as seven), and regardless of whether the second internode is short or long, the last internode of the year is almost invariably short (Figs. 2 and 3). Second, the "primary" whorl of branches arising from overwintering lateral buds and marking the beginning of the year's growth usually includes more and almost invariably includes stouter branches than do the "secondary" whorls marking the beginnings of later internodes of the same year (Fig. 3). In practice, then, on a tree unmodified by tip-moth attack, a whorl of relatively stout branches immediately above a short internode and immediately below a long one reliably indicates the start of a year's growth.

FIG. 3.—The four internodes of one year's height increment in loblolly pine; note the greater size and number of primary-whorl branches, as compared to secondary-whorl branches.

Even in loblolly and shortleaf pines in which the stem and branch pattern above breast height had been modified by tip-moth attack, the characteristics just described identified clearly the beginnings of most individual annual increments in height. In some instances, annual height increments obscured by tip-moth injury could be identified by cross-comparison of several height increments and internode patterns on the trees in question with those on adjacent trees. In cases of extreme tip-moth injury, trees were omitted from sampling, not only to avoid possible error in delimiting the 5-year intercept, but also because very severely injured trees were considered unsuitable for evaluating site quality.

In a number of loblolly and shortleaf pine plantations 9 to 12 years old, for which detailed establishment records were available and in which all whorls of branches formed since planting still persisted, it was possible to authenticate the annual height increments above breast height by identifying all the annual height increments in each tree. The annual height increments above breast height were equally clear on trees in slightly older plantations, in which shedding of branches had obscured some of the increments below breast height, and subsequent analysis of the data indicated confirmed the correctness of the identifications.

Ability to identify annual height increments was tested most severely in a longleaf pine plantation 22 years in the field and 23 from seed, for which some annual and some periodic height measurements had been taken and filed 7 to 22 years previously. This plantation had passed the age at which the 5-year intercept would ordinarily be applied. Self-pruning was well advanced, and on most trees only branch scars remained to indicate annual height increments at and for some distance above breast height. Even in this plantation, however, the annual height increments included in the intercepts on 16 of 21 trees were identified without error in the field, as shown by subsequent comparison with the original height measurements.

Effectiveness of the Five-Year Intercept in Differentiating Sites

Analyses were made of intercept and total height measurements, soil descriptions, and establishment records, representing all four species of pine in the study, all-tree samples and dominant- and codominant-tree samples, and the widest possible range of site qualities.

Intercept length was positively correlated with total height at the 1-percent level of significance in 14 out of 22 comparisons made, and at the 5-percent level in three more. These results were not unexpected, as intercept length constituted a considerable portion of the total height of each tree. They served, however, to confirm a prevailing consistency of the proposed new index with the widely accepted indices derived from total height. In the five samples in which intercept length was not significantly correlated with total height, the theoretical considerations already presented, plus in some cases supplementary data as well, strongly suggested that the intercept was the better site index of the two.

In general, intercept lengths had somewhat higher coefficients of variation than did total heights. A conspicuous exception was in the all-tree samples of longleaf pine, in which, because of the notoriously irregular initiation of height growth by this species, the total heights had the higher coefficients of variation. In all species except slash pine (which is noted for relatively uniform height growth, poor differentiation of crown canopy, and tendency to stagnate), sampling only the dominants and codominants markedly reduced the coefficients of variation of total height. Sampling only the dominants and codominants reduced very little, or even slightly increased, the coefficients of variation of the 5-year intercept.

The variability of the 5-year intercepts did not appear to be enough greater than that of total heights to invalidate the intercepts as an index to site in the plantations studied. As shown by *t*-tests of data from paired plantations, sites that differed significantly on the basis of total heights of all trees, or of dominant and codominant trees only, usually differed significantly on the basis of the 5-year intercepts of the same trees. Similarly, sites not differing significantly in total heights ordinarily did not differ significantly in 5-year intercepts.

When exceptions to the foregoing relationships occurred, there was sometimes direct evidence that the 5-year intercept more accurately expressed the true relationship of the sites. For example, in an 18- and in a 20-year-old longleaf pine plantation, average total heights of trees of all crown classes were 42.0 and 38.6 feet, respectively. Average lengths of the corresponding 5-year intercepts were 17.0 and 16.1 feet. Even without a correction for age, total heights indicated that the younger plantation was on a significantly better site, whereas the intercepts indicated that the sites did not differ significantly. In this case, however, detailed plantation records showed that the superior height of the younger stand was clearly the result of a light, quick fire 2 years after planting, which had practically eliminated brown spot for all of one growing season and part of a second. In the older stand, uncontrolled brown spot had delayed the initiation of height growth for several years. In this case, the 5-year intercept, which measured growth on the two sites independently of the effects of presence or chance elimination of brown spot, and which indicated no significant difference between the sites, seemed definitely the more reliable measure of the producing capacity of the two soils.

In a second instance, eight loblolly pine plantations, all allegedly 9 years old, were ranged in order of decreasing site quality as judged by examination of the soil, and were annotated to show average 5-year intercept lengths and average annual increases in diameter and

height. The third plantation in the series as judged by soil and by intercept length was seventh in average annual height growth. The discrepancy led to a careful check of the establishment records and the discovery that this one plantation had been established in December instead of in January of the year in question, and hence was actually 1 year younger than the others. Recalculation of its average height and diameter increases moved it up to fifth and third in the series with regard to these two measurements, in better harmony with the soil classification. The intercept index had placed it third in the series at the start, despite the erroneous record of planting date.

Economy of Measurement

In the 1946 test, a 2-man crew made intercept measurements with a steel tape attached to a light extension rod. By repeatedly raising the zero end of the tape, one man measured directly the first annual height increment, the first plus the second, etc., in each 5-year intercept. The second man stood at a convenient distance, verifying the placement of the tape at the upper end of the successive annual height increments, and recording the measurements called out by the first man. Time required, including travel of 50 to 65 feet from tree to tree, averaged 1.3 crew minutes or 2.6 man minutes per intercept. Some time could have been saved by measuring only the total length of each intercept, but measuring cumulatively the five successive annula height increments in each intercept was found to be more accurate, especially with tip-moth-injured pines.

Time required to measure total heights with the Abney level was not recorded, but, because of the difficulty of getting a clear view of each tree top and the necessity of measuring 50-foot base lines, was longer than that required for measuring intercepts.

Summary and Conclusions

1. In coniferous plantations less than about 20 years old, evaluating site quality in terms of height growth during a 5-year period, in the first year of which the tree attained breast height, offers both theoretical and practical advantages over evaluating site quality in terms of the total height-total age relationship. Specifically, the 5-year intercept: (1) does not require curves of height over age for direct comparison of sites in plantations of different ages; (2) is not affected by varying proportions of slow growth below breast height and rapid growth above breast height; (3) does not require exact knowledge of age of the trees, either from records or from evidence in the field; (4) eliminates from the site index most or all of the erratic effects of planting stock, planting technique, and juvenile injuries; and (5) in close stands is easier to measure than total height.

2. A 1946 test of the 5-year intercept method in 31 plantations of four species of southern pines showed that, despite their multinodal habit and the frequent occurrence of tip-moth injury on two species, successive annual height increments at and above breast height can be identified reliably on the vast majority of trees up to 20 years old. Characteristically, the start of each year's height increment is distinguished by a "primary" whorl of relatively numerous, thick branches, below which is a short, late-season stem internode, and above which is a conspicuously long spring internode of the main stem.

3. Generally, though not invariably, 5-year intercepts were significantly correlated with total heights. Except in longleaf pine, the coefficient of variation of the intercept was generally greater than that of total height. Despite their greater variability, the intercepts, as shown by *t*-tests, usually indicated the same significance or nonsignificance of site differences between paired plantations as were shown by total heights. In some instances in which intercepts showed significance and total heights did not, or vice versa, details of plantation history strongly suggested that the intercept was the more accurate of the two indices to site.

4. Measurement of 5-year intercepts was appreciably easier and quicker than measurement of total heights.

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The Uptake of Nutrients by Western Conifers in Forest Nurseries[1]

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THE USE OF commercial fertilizers for the maintenance of soil fertility is common practice in most forest nurseries. Rates of application, however, are quite variable. In some instances, rates are based on soil test data; in others, they are based on recommendations for agronomic crops of the area; while in a few cases they are based on experimental work carried on in the nursery.

Levels of soil fertility for growing various species have been suggested by Wilde (*6*), Wilde and Patzer (*7*), and Youngberg and Austin (*8*). A number of workers have used the amount of nutrients removed by seedling crops as a measure of desirable levels of fertility to maintained. Lunt (*4*) reported a removal of 192 pounds per acre of N, 17 pounds per acre of P, 49 pounds per acre of K, and 58 pounds per acre of Ca by 2-0 white pine seedlings at the Peoples Forest Nursery in Connecticut. Mayer-Krapoll (*5*) reports a 21, 7, 11, and 18 pounds per acre removal of nitrogen, phosphoric acid, potash, and lime, respectively by 2-year seedlings of spruce, pine, and fir in small state nurseries and 65, 22, 39, and 54 pounds per acre in large private nurseries in Germany. Cossitt, et al., (*1*) estimated that 2-year old white pine seedlings remove 94.6 pounds of nitrogen, 31.8 pounds of phosphoric acid, and 41.6 pounds of potash per acre. Similar data for western species are lacking, although Lunt (*4*) reported a removal of 94 pounds per acre of N, 14 pounds per acre of P, 23 pounds per acre of K, and 79 pounds per acre of Ca by 2-1 Douglas-fir in the Peoples Forest Nursery.

Although the use of nutrient removal data for determining fertility requirements has certain limitations, it does give an idea of the magnitude of the drain on soil nutrients and needs for replenishment by fertilization. It also points up the luxury consumption of certain nutrients in some nurseries. As a portion of a larger study of nursery soil fertility, the uptake of nutrients by several western conifer species was investigated. Samples of seedlings were collected from forest nurseries in California, Oregon, Washington, and British Columbia. The samples were analyzed for content of nitrogen, phosphorus, potassium, and calcium. The results of this study are reported in this paper.

The forest nurseries from which seedling samples were obtained are situated on a variety of soil types and topographic conditions. A brief description of the soils from the nurseries is presented in Table 1.

The fertility status of the soils of these nurseries is summarized in Table 2. These data are average

TABLE 1.—BRIEF DESCRIPTION OF SOILS BY NURSERY OF ORIGIN

Nursery	Agency	Soil
Magalia	California Division of Forestry	Aiken clay loam—developed from basalt residuum; clay B horizon.
Ben Lomond	California Division of Forestry	Sheridan sandy loam — developed from residuum from quartz diorite; sub-soil is sandy loam slightly higher in clay.
Parlin Fork	California Division of Forestry	Hugo clay loam—developed from weathered shale; clay B horizon; contains numerous shale fragments.
Mt. Shasta	U. S. Forest Service Region 5	McCloud sandy loam—developed from partially weathered, loose volcanic deposits containing considerable pumice; rapid permeability in whole profile.
Corvallis	Oregon State Board of Forestry	Aiken clay loam developed from basalt residuum.
Bend	U. S. Forest Service Region 6 (Oregon)	Deschutes loamy sand — developed on sandy pumice material, overlying basalt at 18 inches. (Non-forest soil in Juniper-sage brush type.)
Wind River	U. S. Forest Service Region 6 (Washington)	Wind River sandy clay loam—developed on mixed basaltic and pumice alluvium; high shot content.
Capitol	State of Washington Division of Forestry	Olympic clay loam—developed from basalt residuum; clay B horizon.
Greeley	Forest Industries Nisqually, Washington	Sultan silt loam developed on silty recent alluvium; water table at 3 to 4 foot depth.
Quinsam	British Columbia Forest Service	Non-correlated; loam surface high in organic matter; semi-permeable layer at 2-3 feet.
Green Timbers	British Columbia Forest Service	Alderwood sandy loam developed from glacial till with cemented hardpan at 2-4 feet.
Duncan	British Columbia Forest Service	Non-correlated; developed on silty alluvium.

[1]Technical Paper No. 1089. Oregon Agric. Expt. Sta., Corvallis, Ore.

[2]Dr. Youngberg has subsequently joined Monsanto Chemical Co., St. Louis, Mo.

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values for three or more representative samples for each nursery. Analyses were made by the Oregon State College Soil Testing Laboratory. pH was determined by the glass electrode method using a 1:1 soil water mixture, organic matter by a modified Walkley-Black method; total nitrogen by the Kjeldahl method; available potassium, calcium, and magnesium on the flame photometer after extraction with neutral 1 N ammonium acetate; and available phosphorus by the sodium bicarbonate method.

Randomly selected samples of seedlings were packed in the usual manner for shipping and sent to the Soils Department, Oregon State College in the fall of 1954. The seedlings were then washed free of all soil particles, dried in a circulating air oven at 70°C., weighed, ground in a Wiley mill, and stored in air tight bottles. Calculation of dry weight production was made using the seedling weight figures and seedling inventory and seedbed area data furnished by the nurserymen.

Douglas-fir (*Pseudotsuga menziesii* [Mirb.] Franco) samples were obtained from the Parlin Fork, Corvallis, Capitol, Wind River, Greeley, Quinsam, Green Timbers, and Duncan Nurseries; ponderosa pine (*Pinus ponderosa* Laws) from the Mt. Shasta, Bend, Magalia, Corvallis, and Capitol nurseries; Jeffrey pine (*Pinus jeffreyi* Grev. and Balf.), from the Mt. Shasta and Magalia nurseries; sugar pine (*Pinus lambertiana* Dougl.) from the Magalia and Wind River nurseries; noble fir (*Abies procera* Rehd.) and Sitka spruce (*Picca sitchensis* [Bong.] Carr) from the Greeley and Wind River nurseries; Shasta fir (*Abies magnifica* var. *shastensis* Lemm.) from the Capitol nursery; Port-Orford-cedar (*Chamaecyparis lawsoniana* [A. Murr.] Parl.), from the Greeley, Wind River, and Corvallis nurseries; and Monterey pine (*Pinus radiata* D. Don), big tree (*Sequoia gigantea* [Lindl.] Decne), and Arizona cypress (*Cupressus arizonica* Greene), from the Ben Lomond nursery.

Duplicate samples of the ground seedling tissue, which included roots, stems, and needles, were digested with a selenium oxychloride solution (*3*). Aliquots were taken for the determination of potassium and calcium with the Beckman flame photometer and the colorimetric determination of phosphorus. Total nitrogen was determined by the standard Kjeldahl method on samples of the ground tissue.

TABLE 2.—SUMMARY OF FERTILITY DATA FOR SURFACE SOILS (0-7") FROM FOREST NURSERIES IN CALIFORNIA, OREGON, WASHINGTON, AND BRITISH COLUMBIA

Nursery	Soil series	Reaction pH	Avail. P	Avail. K	Avail. Ca	Avail. Mg	Total N	Organic matter
			Lbs/acre				*Percent*	
Magalia	Aiken	5.80	6	508	2,090	505	0.17	6.76
Ben Lomond	Sheridan	5.75	23	442	2,540	393	0.17	6.82
Parlin Fork	Hugo	5.30	45	370	1,630	471	0.09	3.77
Mt. Shasta	McCloud	5.70	20	115	1,430	680	0.17	6.55
Corvallis	Aiken	5.65	25	515	2,460	—	0.12	3.60
Bend	Deschutes	6.60	42	675	1,710	—	0.06	1.25
Wind River	Wind River	5.60	88	1,245	1,860	—	0.17	4.93
Capitol	Olympic	5.15	62	273	540	210	0.17	6.37
Greeley	Sultan	5.77	41	76	2,120	—	0.13	3.00
Quinsam	.....	5.00	85	75	800	—	0.28	7.09
Green Timbers	Alderwood	5:05	20	128	610	240	0.14	5.77
Duncan	.....	6.10	34	180	3,490	300	0.22	6.26

TABLE 3.—DRY WEIGHT PRODUCTION, NUTRIENT CONTENT AND NUTRIENT REMOVAL BY 2-0 DOUGLAS-FIR SEEDLINGS

Nursery	Dry weight production	Seedling nutrient content N	P	K	Ca	Nutrient removal N	P	K	Ca
	Lbs/acre	*Percent*				*Lbs/acre*			
Parlin Fork	4,980	0.91	0.22	0.57	0.23	45	11	28	11
Corvallis	4,345	1.19	0.21	0.63	0.13	52	9	27	6
Capitol	5,680	0.96	0.22	0.59	0.03	54	12	33	2
Wind River	7,080	0.78	0.20	0.57	0.10	55	14	37	7
Quinsam	6,383	1.16	0.24	0.41	0.27	74	15	26	17
Green Timbers	7,600	1.01	0.22	0.59	0.18	76	17	35	14
Duncan	14,950	1.27	0.23	0.63	0.29	187	34	94	43
Greeley	14,080	1.20	0.25	0.75	0.20	169	35	103	28
Average[1]	6,008	1.00	0.22	0.56	0.16	60	13	34	10

[1]Does not include Duncan, B. C. and Greeley nurseries.

Results and Discussion

The dry weight production and nutrient content of the seedlings and the amount of nutrients removed from the soil by 2-0 Douglas-fir are presented in Table 3. The data fall into two groups, one group of six nurseries having an average dry weight production of 6,000 pounds per acre and a second group of two having a production of over 14,000 pounds per acre. This wide variation appears to be due largely to differences in soil moisture during the second year. The usual practice is to irrigate very infrequently, if at all, during the second year. A high water table at the Greeley nursery has resulted, in the past, in subirrigation causing a greater than normal rate of growth the second year. The only information furnished concerning the soils at the Duncan, B. C. nursery was that it is a well-drained fine textured alluvial soil.

The nitrogen content of the Douglas-fir seedlings from the first group appear to be high enough to indicate adequate nitrogen uptake. Gessel and Walker (*2*) suggest a level of 1 percent in needle tissue of the current year as being the level separating nitrogen deficient trees from those that are not nitrogen deficient. In view of the dilution by root and stem tissue, it is probable that the uptake of nitrogen was adequate at the Wind River nursery where the seedlings had a nitrogen content of only 0.78 percent. These seedlings showed no sign of nitrogen deficiency. The higher content of nitrogen and removal of soil nitrogen by seedlings from the soil in the Greeley and Duncan nurseries suggest a luxury consumption of nitrogen. The higher rates also suggest a more rapid

depletion of organic matter from these two nurseries and the need for periodic additions of organic material to the soil. The nitrogen content of all species raised at the Greeley nursery was greater than that of the same species produced in other nurseries, with the exception of Douglas-fir at the Duncan Nursery. This same relationship held true for phosphorus and potassium.

The data for ponderosa pine (Table 4) are similar to those for Douglas-fir but with a slightly higher percentage composition and uptake of nitrogen and potassium. The limited data for Jeffrey and sugar pines suggest a similar trend.

Uptake was, in general, highest for nitrogen, intermediate for potassium and lowest for phosporus and calcium. There were exceptions to this general relationship; Sitka spruce in the Wind River nursery, Port-Orford-cedar in the Wind River and Corvallis nurseries and big tree and Arizona cypress in the Ben Lomond nursery, having a higher uptake of potassium than for nitrogen (Table 5). Port-Orford-cedar, big tree, and Arizona cypress had the highest uptake of calcium. This relationship is in line with the greater calcium uptake by these species under natural conditions.

The relationship between nutrient uptake data and soil test data was good in some instances and poor in others. It should be pointed out again that the soil test data are averages for the various nurseries and do not necessarily represent the sample areas. The low level of available calcium in the soil at the Capitol nursery was reflected in the low calcium content in all species produced at this nursery. Soils from this nursery have consistently tested low in available calcium. On the other hand, the relatively low calcium level in the Green Timbers and Quinsam nursery soils was not reflected in a low content of calcium in the Douglas-fir produced in these nurseries. The three pine species from the Magalia nursery all had low phosphorus contents and this nursery had the lowest level of available phosphorus. The three pine species from the Magalia nursery, ponderosa pine from the Corvallis nursery, and Monterey pine from the Ben Lomond nursery all had low calcium contents while the soils from these nurseries had high soil test results for calcium. The Greeley and Quinsam nurseries had the lowest soil test level for available potassium. The potassium content of seedlings produced at Quinsam was lower than average, and at the Greeley nursery, higher than average. The uptake of potassium by 2-0 Douglas-fir in the Greeley nursery was 103 pounds per acre compared to 76 pounds per acre of available potassium. This suggests two possibilities, *viz.*, a relatively rapid release of fixed or moderately available potassium or the addition of potash fertilizer, a practice that has not been too common in forest nurseries in the West. Here again, the soils from the Greeley nursery have in the past tested consistently low in available potassium.

TABLE 4.—DRY WEIGHT PRODUCTION, NUTRIENT CONTENT, AND NUTRIENT REMOVAL BY 2-0 PONDEROSA PINE, JEFFREY PINE, AND SUGAR PINE SEEDLINGS

Nursery	Species	Dry weight production	Seedling nutrient content				Nutrient removal			
			N	P	K	Ca	N	P	K	Ca
		Lbs/acre	*Percent*				*Lbs/acre*			
Mt. Shasta	Ponderosa pine	6,270	1.11	0.16	0.48	0.21	70	10	30	13
Bend	Ponderosa pine	5,150	1.12	0.16	0.69	0.30	58	8	35	15
Magalia	Ponderosa pine	10,630	0.74	0.09	0.52	0.11	89	10	55	12
Corvallis	Ponderosa pine	6,130	1.26	0.16	0.61	0.08	77	10	37	5
Capitol	Ponderosa pine	6,800	1.11	0.23	0.71	0.03	75	16	48	2
Average	Ponderosa pine	6,996	1.07	0.16	0.60	0.15	75	11	42	10
Mt. Shasta	Jeffrey pine	6,490	1.13	0.14	0.49	0.27	73	9	32	17
Magalia	Jeffrey pine	5,420	0.81	0.09	0.50	0.06	44	5	27	3
Magalia	Sugar pine	10,040	0.88	0.09	0.57	0.06	88	9	57	6
Wind River	Sugar pine	5,700	1.20	0.20	0.72	0.15	68	11	41	9

TABLE 5.—DRY WEIGHT PRODUCTION, NUTRIENT CONTENT, AND NUTRIENT REMOVAL BY MISCELLANEOUS CONIFEROUS SPECIES

Nursery	Species	Dry weight production	Seedling nutrient content				Nutrient removal			
			N	P	K	Ca	N	P	K	Ca
		Lbs/acre	*Percent*				*Lbs/acre*			
Greeley	Noble fir	3,655	0.92	0.20	0.71	0.36	34	7	26	13
Wind River	Noble fir	3,910	0.70	0.20	0.61	0.21	27	8	24	8
Capitol	Shasta fir	1,500	1.23	0.25	0.71	0.04	18	4	11	1
Greeley	Sitka spruce	3,785	1.22	0.20	0.95	0.38	46	8	36	14
Wind River	Sitka spruce[1]	11,600	0.52	0.13	0.58	0.16	60	15	67	19
Greeley	Port Orford-cedar	4,800	1.39	0.24	0.90	0.92	67	12	42	43
Wind River	Port-Orford-cedar[1]	4,570	0.57	0.12	0.74	0.51	26	6	34	23
Corvallis	Port-Orford-cedar	5,380	0.55	0.12	0.72	0.53	30	6	39	28
Ben Lomond	Monterey pine[2]	5,310	1.51	0.13	1.03	0.10	80	7	55	5
Ben Lomond	Big tree[3]	10,690	0.74	0.04	0.82	0.41	79	4	88	44
Ben Lomond	Arizona cypress	13,870	0.64	0.07	0.73	0.63	89	10	102	87

[1]3-0 seedlings.
[2]1-0 seedlings.
[3]Sierra Redwood.

Summary and Conclusions

Samples of seedlings of eleven western coniferous species were collected from forest nurseries in California, Oregon, Washington, and British Columbia. Dry weight production, nutrient content, and nutrient removal were determined. For most species the nutrient removal from the soil was highest for nitrogen, intermediate for potassium, and lowest for phosphorus and calcium. Luxury consumption was indicated by the data from two nurseries. The uptake and content of nitrogen and calcium was lower than for eastern coniferous species and similar for phosphorus and potassium. Soil test data for the nurseries were also presented. In some instances, there appeared to be a good relationship between nutrient content and soil test data; in others, it was poor. This suggests a real

need for additional basic research in tree nutrition and the relation of soil test data to nutrient uptake and responses by tree seedlings.

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Lincoln Ellison (1908-1958)

Dr. Lincoln Ellison, chief of the Division of Range Management Research, Intermountain Forest and Range Experiment Station, U. S. Forest Service, Ogden, Utah, met with a tragic death on March 9, 1958, when he was caught in an avalanche while ski-touring. The accident occurred on Mt. Ogden about one and a half miles from Snow Basin, Wasatch Mountains, Utah.

John Anthony Deane, 25, of Salt Lake City, member of a rescue party searching for Ellison, was killed by a separate slide.

Born August 2, 1908, at Portland, Ore., Dr. Ellison graduated from UCLA in 1931 and received his masters' degree in plant ecology from the University of Minnesota in 1938, subsequently earning his PhD from the latter institution. His early days with the U. S. Forest Service, beginning in 1927, were chiefly in the Northern Region. He directed research activities

at the Great Basin Research Center, Ephraim, Utah, from 1938 to 1945 when he was moved to Ogden to head range management research.

Among his many honors, both scholastic and professional, was a Fulbright Research Fellowship to Australia in 1951-1952 and membership in Sigmi Xi, Honorary Scientific Society. He was a delegate to the Seventh International Grassland Congress in New Zealand in 1956.

Dr. Ellison served in numerous posts marking professional leadership. He had served as chairman of the Intermountain Section of the Society of American Foresters, chairman of the Western Section of the Ecological Society of America, member of the editorial board of *Ecological Monographs*, president of the Utah Academy of Sciences, Arts, and Letters, member of the Awards Committee of the Utah Section, and member of the national program committee of the American Society of Range Management. He recently was made a Fellow of the American Association for the Advancement of Science and was currently a member of the Council of the Ecological Society of America. He was widely known for his writings and speeches in the field of plant ecology and related subjects.

Some Results of the Use of the Bitterlich Method of Cruising in an Even-Aged Stand of Longleaf Pine

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DESPITE THE FACT that the Bitterlich method of cruising was introduced in this country over five years ago (*4*) and is being used now rather extensively in the field, only a few reports on the reliability of this method have so far appeared in print.

Avery (*1*) reported on the results of cruising two forties by the Bitterlich and by the conventional method of 100 percent timber estimate in southeastern Arkansas. The errors in volume of the Bitterlich estimate in this test ranged from −2 to +20 percent.

Hush (*6*), using three critical angles, checked on the accuracy of the method on a 40-acre tract in New Hampshire. With the most commonly used critical angle of 104.18′, the Bitterlich method resulted in an error of −21.6 percent in volume, while the use of a critical angle of 203.38′ reduced the error to −4.6 percent and −7.6 percent in basal area and the volume, respectively.

Deitschman (*3*), working in upland hardwoods of Southern Illinois, found considerable deviation from the true volume and true basal area when Bitterlich method was used. The errors were particularly large when the results were compared for very small areas or small groups of trees.

It would have been purely accidental if the errors were smaller than reported by Hush, Avery, and Deitschman. The tracts used by these workers were too small to yield very accurate results by any method of partial cruising of low intensity.

More recently, Trappe (*8*) reported on the use of prisms in relatively uniform stands of lodgepole pine in Oregon. His report shows significantly greater variation by prism count than by tree measurement on 1/20-acre plots.

One of the reports showing a high degree of accuracy attained through the use of Bitterlich method has been that of two Japanese foresters (*7*) who tried the method on plantations with (presumably) fairly even distribution of stems and certain uniformity of tree sizes.

A very thorough analysis of the results of Bitterlich method used on an extensive scale in East Texas has been made available recently by Grosenbaugh and Stover (*5*). Using data from 655 points and plots, they found extremely small differences between basal areas, cubic foot volumes, and board foot volumes obtained by the point cruise and the plot cruise. From both statistical and practical standpoints, these differences were entirely insignificant.

Problem and Organization of Field Work

The following report deals with the results of cruising of a total of 296.4 acres of second growth longleaf pine on the DeSoto National Forest in southern Mississippi. The field work was done by forestry students[1] in a stand reasonably uniform in tree sizes. A total of almost 30,000 trees varying in size from 5.1 inches to 24 inches in d.b.h. were recorded.

The stand is even-aged (approximately 35 years old); more than 92 percent of stems are in 6, 8, 10, and 12 inch d.b.h. classes. A few older trees, residuals from the previous harvest, are found here and there throughout the stand.

Each of the eight parties of students was assigned a part of the total area of 296.4 acres on which a timber estimate was made by three methods: total estimate by one-chain wide strips; 10 percent estimate by 1/5-acre plot; and the point cruise, the points located at the center of each 1/5-acre plot. The three methods were carried out *simultaneously*. While making the 100 percent count of trees, the party set up plots at 5-chain intervals on every fourth strip. As soon as plot record was completed, the count of trees was made with a prism, from the center of the plot. This organization eliminated the possibility of recording dimensions of any tree differently in any of the three methods of cruising.

The prisms used were of approximately three diopters. Each prism was calibrated prior to its use. The basal area factors varied from 9.85 to 10.35. The same volume tables (one in cubic feet and the other in board feet) were used in all three methods of timber estimating.

In calculation of basal area, trees of pole size (6-8 inches) were handled separately from those of sawtimber size, because the volume of these trees was to be computed in terms of cubic feet or cords, while that of the larger trees in terms of board feet.

Results

Comparative errors.—If the area covered by all parties and comprising a total of 296.4 acres were to be considered as one unit, the result of Bitterlich cruise in terms of total basal area per acre was highly accurate. The basal area obtained by the Bitterlich method is within 1.5 percent of the actual basal area as determined by the 100 percent cruise. The average basal area per acre by the Bitterlich method was 49.60 square feet, that by the conventional 100 percent cruise—48.88 square feet. However, the errors in basal area by individual compartments ranged from −22.7 percent to +103.8 per-

[1]Junior class, Department of Forestry, Oklahoma State University.

TABLE 1.—ERRORS IN BASAL AREA AND VOLUME IN BITTERLICH AND PLOT METHODS OF CRUISING

Compartment	100 percent timber estimate: Basal area per acre of trees 6" & 8"	100 percent timber estimate: Basal area per acre of trees 10" & up	100 percent timber estimate: Basal area per acre of trees All	100 percent timber estimate: Volume per acre in trees 6" & 8"	100 percent timber estimate: Volume per acre in trees 10" & up	Bitterlich estimate: Errors in Basal area of trees 6" & 8"	Bitterlich estimate: Errors in Basal area of trees 10" & up	Bitterlich estimate: Errors in Basal area of trees All	Bitterlich estimate: Errors in Volume Cu. ft. 6" & 8"	Bitterlich estimate: Errors in Volume Bd. ft. 10" & up	10 percent plot estimate: Errors in Basal area of trees 6" & 8"	10 percent plot estimate: Errors in Basal area of trees 10" & up	10 percent plot estimate: Errors in Basal area of trees All	10 percent plot estimate: Errors in Volume Cu. ft. 6" & 8"	10 percent plot estimate: Errors in Volume Bd. ft. 10" & up
	(Square feet)			*Cu. ft.*	*Bd. ft.*						*Percent*				
1	15.036	21.129	36.165	341.9	2330	+88.5	+114.7	+103.8	+80.7	+111.1	+27.4	+94.1	+66.3	+56.6	+100.8
2	9.223	26.939	36.162	156.2	2840	− 9.5	− 11.5	− 11.0	− 3.3	− 12.1	− 2.9	− 12.1	− 9.7	+34.4	− 13.1
3	25.485	37.337	62.822	504.0	4438	+13.4	− 5.2	− .8	− 15.1	− 5.5	+19.6	+13.2	+11.6	+19.7	+ 28.4
4	12.692	26.541	39.233	257.5	3402	+32.6	− 27.2	+ 7.9	+57.7	+ 22.7	+ 4.6	− 8.4	− 4.2	+ 7.9	− 20.9
5	19.859	43.693	63.552	506.4	5484	−35.5	+ 8.2	− 5.4	− 34.6	+ 16.4	−21.9	−12.8	−15.8	− 3.2	4.7
6	14.380	48.512	62.892	374.8	6050	−19.0	− 23.8	− 22.7	− 22.9	+ 19.8	+ 3.7	−17.5	−12.6	− 8.4	14.4
7	19.115	40.862	59.977	487.9	5261	−39.8	− 10.2	− 19.6	− 38.6	+ 3.2	−49.4	−33.4	−38.5	−34.3	10.1
8	14.883	29.511	44.394	339.2	4052	+18.5	− 5.36	+ + 2.6	+16.9	− 1.8	+15.0	+ .3	+ 5.2	+19.8	+ 4.1
All	15.588	33.296	48.884	350.9	4072	+ 4.9	− .13	+ 1.5	+ 4.7	+ 4.6	+ 2.13	+ 2.02	+ 2.15	+ 1.71	+ 5.94

cent.[2] When comparison is made on the basis of still smaller subdivision of the stand, such as grouping of trees by sizes, the errors in basal area become still more pronounced. For example, in one compartment (39 acres) the error in basal area of sawtimber (d.b.h. of 10 inches and up) was as large as +114.7 percent.

There appears to be no strong correlation between the size of trees on one hand, and the magnitude of the error on the other, when comparison is made on the basis of individual compartments; in some cases the error was larger for pole-size timber, in others for the sawtimber. It is of interest to note, however, that the overall error (all 296 acres) in basal area of sawtimber was −.13 percent, while that of pole-size timber +4.9 percent.

The errors in volume generally follow the trend of errors in basal area. This is to be expected insofar as the volume is the function of the basal area on the corresponding unit of land. The error in board foot volume and cubic foot volume by the Bitterlich method was +4.6 percent and +4.7 percent, respectively. Both figures apply to the estimate on the entire tract of 296.4 acres. In individual compartments, the errors varied from +111.1 percent to −38.6 percent.

Since Bitterlich is a form of partial cruising, it would be of interest to compare its accuracy with that of the 10 percent plot cruise of the same area. The data for the two types of partial cruise are found in Table 1.

The error in basal area per acre of all trees by the Bitterlich method was +1.46 percent, while that by the plot method +2.15 percent. The error in basal area of pole-size timber was +4.9 percent by the Bitterlich method as against +2.13 percent by the plot method. The corresponding figures for sawtimber were −.13 percent and +2.02 percent. Errors in cubic foot volumes of pole-size timber were +4.7 percent by Bitterlich and +1.71 percent by the plot method. Board foot volume of trees 10" d.b.h. and larger was overestimated by 4.6 percent by the Bitterlich and by 5.94 percent by the plot method. The greater overall error in basal area and board feet estimates by the plot method is undoubtedly a result of sampling variation, or chance, and not of inherently greater reliability of the Bitterlich method. It should be pointed out here that the intensity of sampling by the Bitterlich method in the pattern applied in this study was lower than the intensity of the plot cruising.

The comparative errors just quoted suggest that under the forest conditions described at the beginning of this report, the results of Bitterlich method of cruising compare favorably with those of the conventional method. It should be added also that the time consumed by the use of the Bitterlich method was much shorter (and hence the cost much lower) than that needed by the plot method.

Cruising intensity.—The reference to the intensity of Bitterlich cruise might be rather puzzling because it cannot be expressed in terms of a single number, in a manner applied to the conventional methods of partial timber estimate. Being a "variable plot" method, Bitterlich cruise samples the area (and the population) in variable intensities, depending on the size of trees (d.b.h.) in question. The larger the tree, the larger is the plot on which such trees are counted, and therefore, the larger is the intensity of the cruise. Using as an illustration the spacing of points used in this study (four chains by five chains, or one point per two acres), trees 10 inches d.b.h. were sampled on plots .055 acres in size, making it a 2.73 percent cruise $\left(\frac{.055 \times 100}{2}\right)$, while trees 20 inches d.b.h. were sampled on plots .218 acres in size, making the intensity of the cruise 10.90

[2] Expression of errors in terms of percentages is based on the comparison with the figures obtained by the 100 percent cruise.

percent $\left(\frac{.218 \times 100}{2}\right)$.

Comparing the intensities used in Bitterlich method when the "points" were located in the centers of circular plots, with the intensity of the plot cruising (10 percent) one can see that the Bitterlich cruise was carried out much less intensively than the conventional plot cruising. Only the trees with 20 inches d.b.h. and larger were sampled to the extent of 10 percent or more. These trees made up only a small fraction of the entire stand (.23 trees per acre of a total of 101.67 trees per acre). The intensity of cruise for the rest of the trees ranged from .98 percent (6 inch class) to 8.85 percent (18 inch class). Approximately 92.5 percent of all stems were in the 6 to 12 inch d.b.h. classes.

The relationship between the d.b.h. and the intensity of cruising when points are spaced 4 chains x 5 chains is shown in Table 2.

Although the overall intensity of Bitterlich cruise cannot be expressed as a single number, it is possible to determine the intensity at which trees of any diameter have been sampled. With the use of 108.14′ critical angle, percent cruise for any d.b.h. class can be computed by the equation p (percent) $= \frac{d^2}{18.3439a}$, where d is d.b.h. and a is the number of acres per point (i.e., the total number of acres in the area divided by the number of established Bitterlich points). For example, with 80 points on one section of land, the intensity of cruising for 10 inch trees would be $\frac{10^2}{18.3439 \times 8}$ or .68 percent. With 320 points per section (the rate used in this study), the intensity of cruise for 8 inch trees would be $\frac{8^2}{18.3439 \times 2}$ or 1.74 percent. The equation applicable to *any* critical angle is p (percent) $= \frac{r^2d^2}{19976.5a}$, where d and a are as in the above equation and r is the ratio of the length of instrument to the length of the crossarm.

TABLE 2.—RELATIONSHIP BETWEEN THE SIZES OF TREES AND CRUISING INTENSITIES WITH THE USE OF 3.00 DIOPTER PRISM (OR 104.18′ CRITICAL ANGLE).

D.b.h.	Plot[1] radius	Plot size[2] (Acres)	Cruising intensity[3] (Percent of land area)
6	16.5	.020	.98
8	22.0	.035	1.74
10	27.5	.055	2.73
12	33.0	.078	3.93
14	38.5	.107	5.34
16	44.0	.140	6.98
18	49.5	.177	8.84
20	55.0	.218	10.90
22	60.5	.264	13.19
24	66.0	.314	15.70

[1]D.b.h. × 33.
[2]Rounded off.
[3]For points spaced 4 chains x 5 chains (corresponding to centers of 1/5-acre plots spaced for 10 percent cruise).

Since Bitterlich method of cruising cannot be described in terms of a single percent of intensity, the decision on the number of points and their spacing in the field should be based on the desired intensity of cruise of a specific d.b.h. class. The cruiser might choose either the average diameter, or the one containing as a class the largest volume, or any other diameter of special significance in the ultimate objective of the cruise.

The number of points needed to attain certain intensity of cruise of any desired d.b.h. class can be computed by the equation offered before but recast for the value of "a" (number of acres per point):

$$a = \frac{d^2}{18.3439p}$$

(For instrument with critical angle of 108.14′.) If, for example, a 10 percent estimate of the 16 inch d.b.h. class is desired

$$a = \frac{16^2}{18.3439 \times 10} = 1.4 \text{ (approximately)}.$$

The figure 1.4 means that there should be one Bitterlich point for every 1.4 acres of the area, or the points should be set up at the rate of the 457 per section

$$\left(\frac{640}{1.4} = 457.1\right).$$

With 457 points per section, trees of 16 inches d.b.h. will be sampled on 10 percent of the area, those smaller than 16 inches d.b.h. on less than 10 percent of the area, and trees larger than 16 inches, on an area larger than 10 percent of the total.

The approximate number of Bitterlich points per section, required to obtain a 10 percent sample of trees of various diameters is:

D.b.h.	Number of points/section Rounded to nearest 10
6	3,260
8	1,830
10	1,170
12	810
14	600
16	460
18	360
20	290
22	240
24	200
26	170
28	150
30	130

For a sample smaller or larger than 10 percent, the number of Bitterlich points would change proportionately. For example, for a 5 percent sample the figures above should be divided by 2. It appears that in most cases of cruising second growth stands, it would be necessary to set up more points than it would take circular plots to attain any specific degree of accuracy.

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Dying of Mature Eastern Hemlock in Cook Forest, Pennsylvania

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COOK FOREST PARK, located in northwestern Pennsylvania along the Clarion River, contains one of the last remnants of the once prevalent virgin white pine-hemlock forests. Within the park there are two stands of virgin white pine-hemlock, totaling 171 acres, and 246 acres of mature cutover mixed hardwoods and softwoods. The remainder of the 6,328 acres is composed of second-growth hardwoods and softwoods.

The Cook Forest Park was purchased and deeded to the commonwealth in 1929. The property was acquired, at a cost of $650,000, through the combined efforts of the state legislature, the Cook Forest Association, and other conservation-minded citizens and organizations.

Many problems have arisen in attempting to perpetuate the virgin stands in their original condition. Windstorms, lightning, insects, diseases, and human influence, have inflicted heavy losses on the over-mature stands.

In the past year considerable attention has been given to the dying of hemlock (*Tsuga canadensis*) in the park. Following an aerial and ground examination by J. E. Ibberson, Dr. F. C. Craighead,[1] and J. C. Nelson on September 28 and 29, 1956, it was decided to conduct a thorough study of the causes and extent of the mortality. The following report is based on the findings thus far.

Partial Cruise of Mature Hemlock Stands

In order to determine the extent and locations of the dead and dying hemlock, a partial cruise was conducted of all mature and overmature stands in which hemlock is present. All virgin white pine-hemlock stands, mature softwood stands, and mature mixed hardwood-softwood designated S-7, S-6, and M-6 on the Cook Forest Park timber type map were cruised. A preliminary examination revealed no abnormal mortality in younger stands; therefore, they were not included in the cruise. One-half-chain wide strips, 20 chains apart, were run on compass lines perpendicular to the contour. The following classification was established for describing the foliar condition of declining trees:

Condition class	*Foliar condition*
1	Needles green throughout crown
2	Discoloration of needles but no needle loss
3	Discoloration and initial needle drop
4	Discoloration and 25 percent defoliation
5	Discoloration and 50 percent defoliation
6	Discoloration and 75 percent defoliation
7	Dead, 100 percent defoliation

All hemlocks within the cruise lines were classified in one of these seven categories. Tables 1 and 2 summarize the results of the cruise.

An estimate, based on the data obtained from the cruise, was made of the total hemlock mortality on the park area.

Dead trees within the cruise strips were examined in an effort to determine the cause of death. The following summarizes the causes of mortality and the percent of examined trees in each category:

Cause of mortality	*Percent of dead trees*
Lightning	25
Partial windthrow	16
Exposure, compaction and calcium chloride poisoning	16
Unknown	43

[1]Chief, Forest Advisory Services, Pennsylvania Department of Forests and Waters; and entomologist, Forest Insect Investigations, Bureau of Entomology and Plant Quarantine, retired.

TABLE 1.—AVERAGE NUMBER OF HEMLOCKS PER ACRE BY CONDITION CLASS

Stand category	Class 1 Healthy	Class 2-3 Yellowing & initial needle loss	Class 4-5 25-50 percent needle loss	Class 6-7 75 percent needle loss or dead	Average number trees per acre all classes
S-7-C[a]	43.0	3.2	3.2	.6	50
S-6	41.0	3.2	.5	2.2	47
S-6-C	38.1	1.9	.9	1.9	43
M-6	38.7	.7	.4	1.1	41
M-6-C	30.6	2.3	–	–	33
Average	39.1	2.0	.5	1.0	42.8

[a]"C" following the type designation indicates stands in which improvement cutting took place during the 1949-1951 salvage and improvement operations.

TABLE 2.—TOTAL MORTALITY BY STANDS

Stand number	Acres	No. dead trees/ acre	Total no. dead trees/ stand
S-7-C	171	0.6	102
S-6	196	2.2	431
S-6-C	50	1.9	95
M-6	624	1.1	686
M-6-C	240	–	–
Totals	1,281		1,314

FIG. 1.—Eastern hemlocks, 30 and 24 inches d.b.h., condition class 7, located on the edge of a gas well clearing. As one tree dies another is exposed and the opening in the canopy gradually becomes larger.

FIG. 2.—Twin eastern hemlocks, 34 and 26 inches d.b.h., of condition class 7. Located along a road in the camping area, these trees had their root system severely affected by soil compaction or direct root injury due to the parking of automobiles. Outer bark on upper portions has been removed by woodpeckers feeding on larvae of *Melanophila fulvoguttata.*

Visible lightning scars were present on 25 percent of the dead trees. However, the total percentage of lightning-killed trees is no doubt higher than 25, since trees are often killed without leaving a visible scar. It is impossible to determine the exact number of trees killed by lightning. In most cases no differentiation could be made between exposure and compaction. Where trees were along park roads, calcium chloride poisoning was an additional factor which might have contributed to the mortality. Because of the difficulty in most cases of determining which of these three factors was the primary cause for mortality, all were grouped together in one category. In addition to the mortality due to exposure and compaction which occurs along roads and trails, several trees located on the edge of natural gas well sites have also died from exposure. (Fig. 1)

A stand of mature mixed hardwoods and softwoods on Seneca Hill which was known to have a high rate of mortality (air reconnaissance September 28, 1956) was given special consideration. Three one-chain-wide cruise lines were run to determine the effects of road clearings, compaction, and calcium chloride poisoning on the incidence of the dying trees. Cruise Line 1 was run along the park road from the Mohawk trail north for a distance of 10 chains. Trees were tallied on one-half chain wide strips on both sides of the road. Cruise Line 2 was run parallel to Line 1, originating 2 chains west of the starting point of Line 1. Line 3 was run parallel to Lines 1 and 2 and originated 2 chains east of Line 1. Data taken on the trees in Line 1 were d.b.h., crown class, condition class, and distance from the road. Since the road effect was not present on trees in Lines 2 and 3, the distance from the road was not measured. All trees 10 inches d.b.h. and over were tallied. Table 3 summarizes the data from the three cruise lines:

Over 10 percent of the trees along the road were dead, whereas there were no dead trees on the two parallel strips located two chains off either side of the road.

TABLE 3.—NUMBER OF TREES BY CONDITION CLASS

Line number	Class 1 Healthy	Class 2-3 Yellowing & initial drop	Class 4-5 25-50 percent needle loss	Class 6-7 75 percent loss or dead
1	21	4	1	3
2	33	1	0	0
3	25	1	0	0

TABLE 4.—DISTANCE OF DEAD OR DECLINING TREES FROM INFLUENCING FACTORS

D.b.h.	Crown class	Condition class	Environmental influence
	CRUISE LINE 1 (½ chain strip on either side of road)		
30	Dom	7	20′ from Seneca road[1]
19	CoDom	7	15′ from Seneca road[1]
22	CoDom	6-7	3′ from Seneca road
16	Int	5	2′ from gas well road, 10′ from Seneca road
12	Int	3-4	15′ from Seneca road
36	Dom	3	30′ from Seneca road[1] 1′ from trail
23	CoDom	3	20′ from Seneca road[1]
34	CoDom	3	1′ from Seneca road
	CRUISE LINE 2 (2 chains west and parallel to the road)		
42	Dom	3	2′ wide basal fire scar
	CRUISE LINE 3 (2 chains east and parallel to the road)		
30	Dom	3	1′ from Mohawk Trail

[1]Indicates trees which were in slight depressions where large quantities of calcium chloride would collect after being leached from the road.

TABLE 5.—BORER ATTACK AND ROOT CONDITION BY CONDITION CLASSES

Condition class	Number of trees examined	Percent living cambium at stump ht.	Percent living roots		Insect attack
			Main	Secondary	
2	3	50	63	55	None to heavy unsuccessful
3	6	45	38	33	Light unsuccessful to light successful
4	3	40	40	25	Medium unsuccessful to medium successful
5	4	15	12	10	Light successful to heavy emerged
6	3	3	0	0	Heavy successful to medium emerged
7	2	0	0	0	All emerged

Table 4 lists the distance from dead or declining trees to what are no doubt influencing factors.

Examination of Felled Trees for Borer Attack and Root Condition

Because of the disagreement in the literature concerning the importance of the hemlock borer (*Melanophila fulvoguttata*) as a primary factor in the death of hemlock, a study was conducted to determine the role of this insect in the mortality of hemlock in the Cook Forest (Fig. 2) Twenty-one hemlocks in various stages of decline were felled and examined for attack by the borer. In order to determine the root condition of the trees, four roots on each tree (one in each cardinal direction) were dug out and examined. Fourteen trees were located in the Seneca loop area, and eight in the Hefferen tract near Forest Drive. The d.b.h. ranged from 12 to 46 inches, with an average of 30 inches. Annual ring counts revealed a variation in age of from 160 to 220 years with an average age of 183 years. Table 5 summarizes the results of the examination.

This examination brought out the facts that the root systems of declining trees are in very poor condition and that *Melanophila fulvoguttata* attack is not successful until more than 60 percent of the roots are dead. *Armillaria mellea* was fairly abundant on the dying roots, but it is felt by most workers to be a secondary organism. No trees in Class 1 were felled or had the roots excavated because cutting healthy trees in the park could not be justified.

Trees in Class 2, where the only abnormal sympton is yellowing of the foliage, were found to have only 55 percent of the secondary roots alive. Signs of pitch-filled galleries and dead larvae were present in the inner bark of one out of the three trees in this class. In Class 3, where initial needle drop had taken place, it was found that only 33 percent of the secondary roots were living. One of the six trees in this class had living larvae working in the cambial zone. The remaining trees contained pitch-filled galleries in the inner bark, but no living larvae.

Weather Conditions

The condition of dying roots followed by borer attack at Cook Forest is very similar to the hemlock mortality described by Graham[2], and Secrest, MacAloney, and Lorenz[3] where they attributed the death of hemlock to a series of drought years. The weather records were examined for the Cook Forest area to determine whether or not drought conditions have existed in the past 12 years. Monthly precipitation records from three weather stations within a 20-mile radius of the park were used to calculate the average monthly rainfall for the park. The only striking precipitation deficit occurred in June and July of 1952. The June total was 1.21 inches, which was 3.16 inches below normal, and the July total of 2.62 inches was 1.94 inches below normal. Although the rainfall for this period was far below normal, it was not serious enough to cause mortality of healthy trees. However, it could have caused considerable root mortality on trees that had been previously weakened by other factors such as exposure and soil compaction.

[2]Graham, S. A. Causes of hemlock mortality in northern Michigan. Univ. of Mich. School of Forestry and Conservation, Bull. No. 10. 1943.

[3]Secrest, H. C., H. J. MacAloney, and R. C. Lorenz. Causes of decadence of Hemlock. Jour. Forestry, 39: 3-12. 1941.

Future Studies

In order to determine the rate of decline of affected trees and to further study the causes of decadence of hemlocks, 72 trees were tagged for future observation. Twenty-two trees in various stages of decline, and 50 apparently healthy trees, were marked. Detailed data as to the present foliar condition were taken on each tree. All tagged trees will be observed annually for the next five years. From this study, data will be obtained by which we can determine the significance of trees in classes 2 to 5.

Summary

A partial cruise of all mature and over mature stands indicated that there is an average of one dead hemlock per acre and an estimated total of 1,314 dead hemlocks on the forest. (See Tables 1 and 2). These trees have been dying over a period of years. Many have been dead from 10 to 15 years. There is no indication of an increase in mortality in recent years. According to the 1949 Cook Forest Inventory, there were 7.65 defective hemlocks per acre in the S-7 stands. There were 5.6 hemlocks per acre which were either dead and standing or had been blown down and were still salvagable.

The greatest known cause of mortality is lightning. Twenty-five percent were definitely lightning strikes, and possibly many more could be attributed to this cause. Partial windthrow and exposure and compaction each contributes 16 percent of the total mortality. Forty-three percent of the trees died of causes unknown. No doubt

many of these unknown trees would fall into one of the known categories if their histories were known. On the examination, any tree whose mortality could not be definitely classified by a known cause was tallied "unknown."

Of the mortality that is occurring in the park, 16 percent can be attributed to changes in the environment due to man's activities. Through proper road and trail layout, curtailment of calcium chloride applications, and periodic rotation of picnic areas, this mortality could be greatly reduced.

An examination of trees in various stages of decline revealed that the hemlock borer was not able to attack successfully until more than 60 percent of the roots were dead. (See Table 5). The insect was therefore eliminated as a primary factor in the hemlock mortality.

A study of the weather records for a 12-year period did not reveal the existence of drought conditions. There was, however, a two-month period in mid-summer of 1952 when there was a deficit in precipitation. This dry period could possibly have caused mortality of rootlets and thereby hastened the death of previously weakened trees.

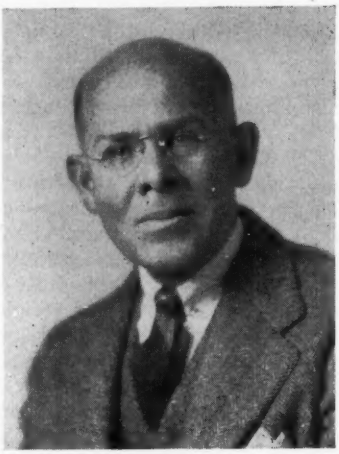
In order to obtain additional data on the decline of old growth hemlock in high use areas, 72 trees were tagged for future observation.

G. H. Collingwood (1890-1958)

George Harris Collingwood, 67, died suddenly in his home in Washington, D. C. on April 2. One of America's best known foresters, he was an authority on the history and legislation of natural resources management. At the time of his death, he was head of of the Natural Resources Section of the Library of Congress Legislative Reference Service.

Born May 27, 1890 in Fayetteville, Ark., Mr. Collingwood was graduated in 1911 with the B.S. degree in forestry from Michigan Agricultural College, now Michigan State University. Subsequently, during 1912-1913, he studied forestry at the University of Munich, and visited forest areas in western Europe. In 1915 he went to the University of Michigan, and in two years later received the A.M. degree, majoring in economics.

His long professional career began with a couple of years in the U. S. Forest Service in Arizona. In 1916 he was appointed assistant professor of forestry extension at Cornell where he remained until 1923, when he was named extension forester in the U. S. Department of Agriculture, Washington, D. C.



Designated forester for the American Forestry Association in 1928, he played a leading role in the development of national conservation activities during the next twelve years. The National Lumber Manufacturers Association appointed him chief forester in 1940, and for the following six years he helped promote the forestry activities of the industry.

In 1946 he became director of forest products for the National Housing Agency, and two years later was retained by the Hoover Commission as research director of agricultural activities.

After serving one year as forestry consultant to the Chamber of Commerce of the United States, Mr. Collingwood in 1949 went with the Library of Congress as an analyst in conservation and natural resources, the office he held at the time of his death.

The recipient of the Michigan State College alumni award in 1954, he also received the American Forestry Association's conservation and distinguished service awards in 1956.

He was a Member of the Society of American Foresters, a Fellow of the American Association for the Advancement of Science, a long-time member and former honorary vice president of the American Forestry Association, and other conservation organizations.

A well-known writer on forestry subjects, he was a frequent contributor to conservation magazines and professional journals. He was the author of several bulletins and the popular book, *Knowing Your Trees,* first published in 1937.

Notes

Controlled Environmental Conditions Influencing The Effects of Petroleum Naphtha on Slash Pine Seedlings

The optimum environmental conditions during and after post-emergence applications of petroleum sprays on conifers are questionable. Such factors as the age and vigor of the seedlings, soil moisture, the species involved, and the rate and type of chemical applied affect the susceptibility of seedlings to damage; however, the results are also greatly influenced by temperature, light intensity, and humidity during and after treatment.

In a report (*2*) covering the experience of forest tree nurserymen, it was generally believed that less danger to coniferous species resulted when the spraying was done during the cool periods of the day, when the humidity is usually higher, and at low sun radiation. Stoeckeler (*5*) reported that shading reduced oil injury to white spruce (*Picea glauca* [Moench.] Voss.) from 29 to 80 percent for unshaded beds down to 2 percent or less for shaded beds. Furthermore, injury to jack pine (*Pinus banksiana* Lamb.) appeared to be slightly greater when spraying was done on warm rather than on cool days, and by day rather than at night when air temperatures are lower. Cossitt (*1*) concluded that high soil moisture and air temperatures between 70°F. and 80°F. decrease the susceptibility of young pine seedlings to mineral spirits; however, older seedlings will tolerate greater amounts applied at higher temperatures. It has been noted that heavier applications of mineral spirits are less damaging to conifers in northern nurseries than in warmer southern nurseries (*3*).

While investigating the morphological and histological modifications of pine seedlings induced by petroleum naphtha (*4*), the authors observed that the seedlings reacted differently to the spray depending upon the varying environmental conditions. For this reason and because the effects of environmental conditions are questionable, it was decided to study the effects of petroleum naphtha on pine seedlings when applied under controlled environmental conditions.

Slash pine (*P. elliottii* Engelm.) was grown in the greenhouse in 6-inch clay pots. Approximately 1,100 two-month-old seedlings were placed in the Purdue Controlled-Climate Facilities which consisted of three artificially illuminated rooms. Each of the rooms was maintained at a different temperature, namely 50°F., 70°F., and 80°F. The air conditioning equipment maintained the temperature in each room within two degrees of the desired temperature. Each room operated at a temperature from two to four degrees higher during the light period (eight hours) than during the dark period. In addition, during the light period there was approximately a four degree differential between the top of the room near the lights and the floor. The maximum light intensity attainable was approximately 1,800 foot-candles. A lower intensity of 400 foot-candles was obtained by shading the plants. The seedlings were given three applications at the rate of 50 gal. per ac. with undiluted Standard Weed Killer. It is a Stoddard solvent naphtha—a petroleum fraction consisting of a mixture of hydrocarbons. The oil, with a boiling range of 300-400°F., is primarily paraffinic in nature, but does contain about 10 percent aromatics. The spray was applied with a Hudson hand sprayer with an adjustable nozzle. A computed amount of spray was directed on the plants in each pot taking into consideration its soil area.

TABLE 1.—PERCENT MORTALITY OF SLASH PINE ONE MONTH AFTER TREATMENT WITH THREE APPLICATIONS OF STANDARD WEED KILLER AT THE RATE OF 50 GAL. PER ACRE

Light intensity Ft.-c	Temperature °F. 50	70	80
400	0	23.1	29.0
1,800	5.3	27.5	37.5

Although the plants appeared normal for a number of hours following treatment at 70°F. and 80°F., ultimately injury became apparent. The leaves, especially the younger ones, became bright green and spread apart or drooped from the growing tip giving the seedlings a flattened appearance. The growing tip became quite flexible and the leaves yellowish green; this was followed by a browning of the leaves and drying of the hypocotyl. Once these symptoms had appeared, mortality was rapid and as great at 70°F. as at 80°F. Three months after treatment, there was a minority of undamaged seedlings at the higher temperatures but less damage was evident at 50°F. Less injury was evident at the lower rather than at the higher light intensity. The results are summarized in Table I. Preliminary investigations indicated that high humidity during and after treatment may have an adverse effect upon the seedlings.

The results indicate that environmental conditions during and after treatment are of prime importance and oil injury increases when applications are made at higher temperature, higher light intensity, and perhaps higher humidity. In other studies (*4*), it was observed that older seedlings were more tolerant. It was also established in this earlier work that there are species differences in response to petroleum oils, slash

pine being more susceptible to the spray than Scotch (*P. sylvestris* L.) or red (*P. resinosa* Ait.) pine.

Although environmental conditions cannot be rigidly controlled in the field during and after applications, spraying should be done under optimum conditions of temperature and light intensity to insure minimum seedling damage.

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J. D. LACROIX and A. T. GUARD

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Basal Spray with 2,4,5-T for Winter Hardwood Control In East Texas

Removal of competing hardwoods is essential to re-establishment of pine on many dry sites. Aerial spraying of silvicides or land-clearing with heavy machinery promises to be useful on extensive operations. For owners of small tracts, however, hand methods that can be applied at planting time are most acceptable.

Search for such a method at the Austin Experimental Forest in east Texas revealed that for December application, and, presumably throughout the dormant season, 2, 4, 5-T is more effective when applied as a basal spray than when painted on cut stumps.

Triplicate sets of plots were treated and planted to loblolly pine (*Pinus taeda* L.) in December 1953, near the beginning of the normal planting season. On one set of plots all hardwoods were basal-sprayed, on a second set all hardwoods were cut close to the ground, and on the third the hardwoods were similarly cut and the stumps painted with silvicide. The silvicide for the first and third treatments was a mixture of 1 gallon of Dow Esteron 245 (a propylene glycol butyl ether ester) in 16 gallons of No. 2 diesel oil, a concentration of 23.5 pounds of acid per hundred gallons. In both treatments the solution was applied to the point of runoff.

Of the original stand of 13-year-old mixed hardwoods, 20 sweetgum (*Liquidambar styraciflua* L.) trees or stumps on each plot were observed for three years. By April 1954, 92 percent of the stumps without silvicide had sprouted, and this increased to 100 percent by the following November. The 2, 4, 5-T solution on cut stumps delayed but did not reduce sprouting: 37 percent of the stumps sprouted by April, 90 percent by November, and 97 percent by April 1955. Untreated stumps produced significantly larger and slightly more sprouts than stumps with silvicide, but by the third growing season sprouts on both treatments had outgrown the surviving pine seedlings.

Ninety-three percent of the basal-sprayed trees eventually died, though more than half of them retained their leaves throughout the first growing season. Only 5 percent of the sprayed trees sprouted.

Relative effectiveness of the treatments as site preparations is revealed by survival of planted loblolly pine seedlings. In November 1954, after a very dry summer, loblolly survival was 53 percent on the plots where silvicide was applied on stumps, 55 percent where stumps were left untreated, and 83 percent where hardwoods had received basal spray. The silivicide had no adverse effect on the pine seedlings under either treatment, even when planting followed its application by only a few hours.

However, none of the three methods afforded an adequate "one shot" release treatment for Texas conditions. After three growing seasons, two of which were very dry, pine survival on the two cut treatments had declined to 45 and 27 percent for the areas with and without silvicide, respectively, while on the basal-spray area it was down to 64 percent. Many of the pines needed release—on the cut areas from hardwood sprouts, and on the basal-spray areas from invading herbs and vines and from the expanded crowns of the few surviving hardwoods. Had adequate release been given at the end of the second year, 80 percent of the pines on the basal-spray areas might have survived, as compared with less than 50 percent on the other treatments.

The poor showing of 2, 4, 5-T solution on cut stumps appears to be related to time of application. In tests made during the growing season even more dilute solutions on cut stumps have permanently inhibited sprouting. For applications concurrent with planting, which must be done during the dormant season, 2, 4, 5-T is apparently best applied as a basal spray.

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Parliament of Science Held

Under the auspices of the American Association for the Advancement of Science, a Parliament of Science was held in Washington on March 15-17, 1958. The purpose of the conference was to discuss problems of science and public policy affecting the support of science and the improvement of science education. Some 130 participants and approximately 100 observers conferred at the Sheraton-Park Hotel, on the following five major topics:

1. The Support of Science;

2. The Organization and Administration of the Nation's Scientific Effort;

3. Communication Among Scientists and Communication of Scientific Information;

4. The Selection, Guidance, and Assistance of Students for Scientific Careers; and

5. The Betterment of Teaching and Education Generally, as Well as in the Sciences.

The conferees agreed on several general principles:

1. Scientific endeavor is one phase of human intellectual effort, and in order to flourish must be correlated with humanistic efforts;

2. In order to be wisely applied to human welfare, scientists must be free to communicate with each other and with the public; and

3. Scientists are concerned with the finding of new truth, and as citizens they have responsibility to indicate the social consequences of their scientific findings.

As a corollary of these principles, it seemed to be the majority view that we are tending to overemphasize the need for people educated in the physical sciences, mathematics, and engineering. Although men of these kinds are needed, it is also necessary to train more natural and social scientists, and to teach all scientists to be better citizens.

As to the organization of science, the coordinating function of the National Science Foundation was strongly recognized and endorsed. It was judged unnecessary, however, for a separate Department of Science to be set up in the federal government. It was also considered undesirable to have a separate "West Point of Science," in which scientists would be trained under federal auspices.

The following statement is quoted from the "Conclusion" of the draft report of the Parliament: "Although this Parliament of Science has quite properly concentrated on problems of science and public policy, and although some of the recommendations are quite specific to science, it must be emphasized in conclusion, as it was in beginning, that science represents only one part of intellectual endeavor. Both public policy and the welfare of science require an educational system that is strong at all levels and in all fields of knowledge. Efforts to advance science at the expense of other fields of learning would harm all fields of learning and the society they serve."

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Size Range of Southern Pine Poles

In connection with other studies, monthly reports were gathered by the Forest Service from treating plants in the South showing pine poles received during 1956 by length and class. The wood-treating plants reporting included most of the large plants in the South. During 1956 they treated 65 percent of all poles treated in the South and 54 percent of all southern pine poles treated in the United States. The number of poles reported received at these plants was 2,312,375. Since 90 percent or more of poles used are treated, the size data are considered representative of all southern pine poles.

Table 1 shows the percentage of these poles in each standard length and class. Classes follow American Standards Association's specifications for southern pine poles. Class 8 was not used in reporting. Reports were requested for only those classes and lengths for which data are given. Poles larger or smaller in circumference than the classes shown were included in the nearest class.

Certain limitations of these data should be realized. Since the information came from a selected group of treating plants, it may not be wholly representative. The data include not only utility poles, but also poles for pole-frame construction and possibly poles for other uses. In spite of these limitations,

TABLE 1.—DISTRIBUTION OF SOUTHERN PINE POLES BY LENGTH AND CLASS, 1956

Length	Pole class[1] 1	2	3	4	5	6	7	9	10	Total by length
Feet	*Percent*									
16	—	—	—	—	—	0.46	0.27	0.55	0.71	1.99
20	—	—	—	—	—	0.83	1.32	1.82	2.06	6.03
25	—	—	—	—	—	2.81	4.72	5.64	2.25	15.42
30	—	—	0.92	1.48	2.71	4.49	7.50	—	—	17.10
35	—	—	1.80	4.96	8.80	8.70	3.72	—	—	27.98
40	—	1.05	2.18	6.49	8.16	—	—	—	—	17.88
45	—	0.58	1.63	2.74	2.16	—	—	—	—	7.11
50	—	0.50	0.99	0.89	0.16	—	—	—	—	2.54
55	0.29	0.33	0.58	0.38	0.05	—	—	—	—	1.63
60	0.08	0.29	0.42	0.31	0.02	—	—	—	—	1.12
65	0.06	0.17	0.25	0.15	—	—	—	—	—	0.63
70	0.05	0.11	0.12	0.06	—	—	—	—	—	0.34
75	0.05	0.09	0.07	0.02	—	—	—	—	—	0.23
Total by pole class	0.53	3.12	8.96	17.48	22.06	17.29	17.53	8.01	5.02	100.00

[1]American Standards Association classes are based on minimum circumference at top and 6 feet from the butt. A class 5, 35-foot pole, for example, must have a minimum circumference of 19 inches at the top and 30 inches six feet from the butt.

however, the pole size data should be useful for many purposes.

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Direct Seeding Yellow-Poplar

Direct seeding shows promise as a method of establishing yellow-poplar (*Liriodendron tulipfera* L.) in forest openings. Two large openings created by a harvest cut were used to test direct seeding in southern Indiana. Half of each opening was disked to find out if disking aids yellow-poplar establishment. Eight ½-chain-square plots were established in each opening, four disked and four undisked. One opening is on a west-facing slope and the other is on an east-facing slope.

The openings were disked and seeded in February 1957. Stratified yellow-poplar seed was broadcast at the rate of 120,000 seeds per acre on half the plots. The remaining plots were checks to evaluate natural reproduction. Seed viability was estimated as 10 percent when collected.

In late August 1957 there were nearly 1,800 yellow-poplar seedlings per acre on the seeded plots, and 1,000 seedlings per acre on the unseeded areas. A small poplar tree on private land near the study area cast seed on the west slope opening. Apparently spring rains washed some seed from seeded plots to unseeded plots and some seed was lost from the study area. Even so, there were approximately 800 seedlings per acre attributable to direct seeding.

Nearly six times more yellow-poplar seedlings were found on the seeded plots on the west-facing slope than on the seeded plots of the east-facing slope. Although the east slope is generally considered a better site, no explanation can be given for the poorer germination.

There was no difference in the stocking of yellow-poplar seedlings on disked and undisked areas. However, one-third of the undisked area was scarified during logging. Within the undisked area there were six times more yellow-poplar seedlings per unit area on scarified ground than on unscarified ground.

Much work remains to be done before specific recommendations can be made for direct seeding yellow-poplar. Season of seeding, rate of seeding, sites to seed, seedbed requirements, and the use of repellents all need testing. The importance of this species and possibilities of low-cost establishment justify further efforts.

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A Method of Measuring Water Use By Forests on Slowly Permeable Soils

A unique method for measuring consumptive use and transpiration of water by forests was devised for a study near Stoneville, Mississippi.

A 30-acre drainage area of Sharkey clay soil was dammed in January 1956 and 2 feet of winter rainfall impounded. Forest cover was a well stocked 50- to 60-year-old stand of hardwoods. The daily drop in lake level was measured during the spring and summer growing season and designated consumptive use or evapotranspiration. Evaporation loss measured from a pan anchored in the lake was subtracted from the total drop in water level of the lake. The difference was that used by the forest stand, as soil seepage through an impermeable clay like Sharkey was deemed negligible during the period of study.

Water use as measured by this method was consistently near 0.20 inch per day in May and June, averaged 0.35 inch per day in July, and during August rose to 0.50 inch daily. While the data are from preliminary tests, and are in no way considered conclusive, the rates for May and June corroborate those obtained elsewhere. The rates for July and August are higher and therefore must be investigated further.

The method offers advantages over other laborious and time-consuming procedures wherever impervious or even slowly permeable soils are present.

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[1]In cooperation with the Mississippi Agricultural Experiment Station and the Southern Hardwood Forest Research

Points of View

Basic Research in the Biological Aspects of Forestry as Influenced by Training, Experience, and Facilities

In an earlier note[1] it was pointed out that in order to make important improvements in the state of the forestry arts more research is needed that concerns itself with the *"why" of* certain biological relationships. Such research was termed basic research and as conceptually applied to the biological aspects of forestry was defined as ". . . research which is oriented toward determining *why* and is synonymous with fundamental research."

In the April issue of the JOURNAL W. E. McQuilkin[2] asks "If a piece of research is not basic and not applied, what kind of research is it?" I believe it can be simply stated as non-basic research without apparent application. However, McQuilkin appears to be under some compulsion to support a concept of basic research which he feels is ". . . in accord with most present-day usage wherein all research commonly is classified as basic or applied." He considers basic research as ". . . any research of whatever subject or scope if done without applicability to an operational problem . . . regardless of the orientation or motivation, regardless of foreseeable practical significance, and regardless of whether it simply contributes another item in an established field of study, or whether it opens a completely new vista in science." What he fails to provide for in his definition is research which is not oriented toward solving an operational problem, but which accidentally does so.

In the same issue of the JOURNAL Earl Stone[3] points out that discussions of pure, basic, theoretical, fundamental, and academic research ". . . ceased to be meaningful for the writer about 10 years ago after reading James Conant's reflection on science and the practical arts." He suggests that ". . . our test of good forest research should be not whether it is basic or non-basic, but rather is it relevant; is it well done; will it reduce the degree of empiricism in its area?"

I do not believe the concept of basic, non-basic, and applied research should be confused with research quality, generally described as "good," "relevant," and "well done." Nor do I believe the intent of the researcher or the applicability of the research to an operational problem should be confused with the researcher's training, his professional experience or the availability of research facilities. However, academic training, professional experience and the availability of research facilities is certain to influence the effectiveness of anyone carrying on basic research—trying to find out *why*.

For purposes of illustration let us consider an extreme example. Take two boys, seven and nine, both of whom are engaged at the moment in basic research. They are making an earnest attempt to determine *why* electricity passes through a piece of copper wire, but not through a piece of wood. The nine year old, because of the additional training in science he has received in the third and fourth grades has more ideas to try than the seven year old who is in the second grade. I am reasonably certain that neither child will be able to come up with a *why* that most of us would be willing to accept. However, both children have already been able to determine *what* happens when an electrical source is connected to one end and an ammeter to the other end of either a piece of copper wire or a piece of wood. Even should the necessary physical facilities be made available to them they would still be unable to supply the answer *why* because of the lack of sufficient training. On the other hand every college graduate in physics because of his advanced training in science knows the reason *why* electricity readily passes through copper and not through wood and could readily repeat the experiments that are the basis for the explanation.

A comparable situation, although of a different order of magnitude can be found within our forestry research organizations and points up our needs for better training and facilities. Those men now engaged in research in the various biological aspects of forestry have a wide range of academic training and on-the-job experiences. Accordingly, some of these men are well qualified for basic research, some only partly qualified, and and some unqualified. Furthermore, some of them have better research facilities than others. Let us consider how this combination of training, experience, and facilities can affect the researcher's ability to do basic research.

Academic training is indicated in part by the degree attained and we find some researchers with bachelor's degrees, some with master's degrees, and some with doctorate degrees. However, this does not mean that men with the same academic degree have been exposed to the same educational experience. For example, even though all accredited schools of forestry must expose the student at the undergraduate level to courses in plant physiology, soils, and ecology, the exposures are not necessarily similar. In plant physiology, students at all forestry schools hear about photosynthesis; in soils they all hear about podsolization; and in ecology they all hear about plant succession. But at only a few schools is the biochemistry of the photosynthetic process treated in detail and a conscientious effort

[1]Stone, Edward C. Basic research in the biological aspects of forestry. Jour. Forestry 55:672-673. 1957.

[2]McQuilkin, W. E. Basic research—what is it? Jour. Forestry 56: 222-223. 1958.

[3]Stone, Earl L. More on basic research. Jour. Forestry 56: 223. 1958.

made to relate the physiology of the plant to its performance on particular soils under specified ecological conditions.

At the master's level an effort is generally made to broaden the student's outlook. No longer are all relationships presented to him in terms of black and white. Intermediate hues become an important feature of the color scheme. In other respects the training varies with the student and type of master's degree (MF or MS). One student may select a number of courses basic to the understanding of a particular biological aspect of forestry while another may select only survey courses covering the entire field. One student may carry out a supervised research problem and prepare a thesis while another may substitute an oral examination.

At the doctorate level the effort to broaden the student's outlook continues. Repeatedly, he is forced to examine and re-examine the foundations upon which the various biological aspects of forestry rest and few if any relationships are still regarded in terms of black and white. But again one cannot generalize broadly. The specific courses taken vary with the student, with the type of degree (DF or PhD) and with the particular school. In the latter respect whatever peculiarity exists in staff training is generally reflected in the course requirement and the caliber of the courses. Schools staffed with personnel trained in the basic disciplines underlying the biological aspects of forestry tend to encourage student specialization in one of these disciplines. Schools staffed with personnel trained in what is referred to broadly as ecology and silviculture tend to encourage breadth of training, training that often touches upon each of the underlying disciplines, but rarely treats any one in detail. Consequently, students from one school may be trained for and motivated toward research dealing with *why;* from another school students may not be trained to explore *why* much beyond the first apparent correlation between distribution or behavior and the environment.

Experience is certain to broaden the researcher's point of view relative to forestry problems, but it will not necessarily increase his effectiveness in basic research. Generally his ability to assess *what* is happening in the forest will be improved as will his ability to talk about it. However, his ability to determine *why* it happens may show little improvement over the years principally because specialized training in a particular underlying discipline is needed, and this is difficult to acquire away from school. Motivation may be strong, but proficiency in such a discipline even at a university requires three or four years of study on a full time basis. Faced with an eight hour day on his job and family responsibilities at home the average researcher in forestry is not going to do much about learning an underlying basic discipline.

Facilities are necessary if the researcher is to carry on in an efficient manner. Some studies, in particular where an attempt is being made to measure *what* is happening, may require nothing more than transportation, a note book, a pencil, a calculator, and access to a good library. For example the determination of the successional pattern within a specific area might require nothing more. However, such data are of limited value in any attempt to interpret plant behavior some distance away. For wide application information is necessary on *why* the plants in an area behave as they do when associated and therefore present a particular successional pattern. To obtain this information the researcher needs in addition to transportation, a note book, a pencil, a calculator, and a good library, facilities not now generally available. He needs control of the environment which can only be obtained in special greenhouses or light chambers. He needs a well equipped soil and biochemical laboratory and special equipment for measuring photosynthesis and respiration—all together a considerable capital investment.

A few research administrators have recognized this need for modern facilities. But to many an administrator who has painfully pulled himself up through the ranks and has long been exposed to "good" research successfully conducted with only meager facilities, requirements of this sort may sound fantastic.

So what happens to those few fortunates who have received a training in a basic discipline underlying forestry, who have an understanding of modern research methods, and who have used and are familiar with modern research facilities? Again we cannot generalize; however, let us consider the hypothetical case of Mr. Basic who has such a training. He has just received his PhD and is eager to carry on in research. He is assigned to a region where planting has met with failure and his first responsibility is to develop a successful planting system. During the first year he reviews the literature, studies the files, and becomes familiar with field conditions. Then after completing a problem analysis he prepares a work plan which involves a number of stages, the last being a series of field plantings with which he plans to evaluate the hypothesis he hopes to develop. His plan also calls for the use of certain facilities—a temperature controlled greenhouse ($100,000—$600,000) and a well equipped laboratory ($50,000—$100,000). When his division chief gets the plan he calls in Mr. Basic, points out that the equipment budget for the entire division averages only $1,200 a year, tells him to start with the field plantings, and ". . . perhaps later it might be possible to build a small inexpensive greenhouse, but close temperature control is entirely out of the question."

Considerably shaken, Mr. Basic looks around for other job opportunities and finds facilities are lacking everywhere he inquires, so he goes back to his university professor and asks his advice. His advice is to take a few uncomplicated problems so that Mr. Basic

can build up his bibliography and in a few years the situation would probably improve. Ten years later Mr. Basic has a bibliography of 200 titles and is a recognized "authority." Although he has buried over a million words in the literature he has not solved the planting problem, nor has he been able to answer *why* once during the entire 10 year period. He is still looking for a good position where facilities are available.

Research can be likened to the building of a road. After the initial trail has been broken considerable effort is required to widen, grade, and make the road passable. The basic researcher—in his search for *why* breaks the trail; closely behind follow the researchers concerned with *what* and *how* who make the road smoother and wider. Obviously we need research to widen the road, but if we are not to spend all our effort in widening a dead-end road some changes in our present *modus operandi* are necessary.

First, each forestry school should reexamine its present PhD program and determine whether or not the student can achieve adequate training for a career of basic research in forestry, if he so desires. If it appears that he cannot, then suitable curriculum should be developed making full use of other departments on the campus, particularly if the forestry school staff is inadequately trained for the tast.

Second, students judged to be capable of taking the necessary training and subsequently doing basic research should be encouraged to orient their course work and career aspirations in this direction. The advancement of forestry will depend upon such men.

Third, the U. S. Forest Service should initially concentrate its basic research activities at a limited number of stations. By so doing, inadequate facilities now scattered at the various stations throughout the country could be eliminated. The money thus made available could be used for building one or more adequate installations where the forester in his search for *why* would no longer be limited by facilities. To some degree this is now underway.

Fourth, men trained for basic research and who will use the facilities should be allowed to plan the facilities and not the administrator, who for all his proven ability to deal with people and papers may never have been an active participant in basic research.

Fifth, the forestry schools should make an earnest attempt to improve their present research facilities. A new forestry building with pleasant offices and spacious lecture halls may look good to the alumni, but unless the graduate student is provided an opportunity to work with modern research facilities he will start off on his research career equipped with blinders which he may never know he wears.

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The Communication of Ideas by Foresters

As we all know, the aims of science are, first, to find out, and second, to tell others what has been observed so that the findings may be tested and put to use.

Communication, or the telling to others, is efficient when the messages are attractive in form and substance.

Some kinds of knowledge can hardly be expressed except in specialized forms that tend to shut out all but the initiates, since few of us are attracted by difficult puzzles. The use of special language and devices all too often extends far beyond the areas where they are needed and useful. It is, of course, a vain hope that many readers, professional or otherwise, will struggle dimly through obscure and remote language. Most of us like clear, lively, and pointed language.

A Scotsman, Gilbert Highet, has appealed to Americans because he has something to say and says it in a style we like. In his book, *The Classical Tradition* (Oxford University Press 1949 and 1953), he recalls how the study of Greek and Latin has suffered from several ills of communication which he describes with humor and feeling. In the first place, the scholar on the eve of World War I had available in libraries fifty times the volume of knowledge that was on hand for his predecessors of 1814. The great increase in knowledge of the classics and classical times stemmed from manuscripts and archeological material uncovered in the Mediterranean area, from analysis by scientific methods, and from the collection of whole masses of findings into books and reports easily reproduced on the new paper and presses. New railroads permitted frequent meetings for exchange of ideas.

However, the spreading of this knowledge had begun to fall off toward 1880, as the classics gradually lost their long primacy in the world of thought. The sciences were moving in.

Highet finds that the classics lost their audience chiefly because the effort of scholars became specialized in extending knowledge rather than in making it available and digestible for others. The author pays his tribute also to the style of writing adopted by some, "often deliberately repulsive." He quotes another, "In the name of science they have cultivated difficulty and gracelessness." Are foresters of our day inspired to count and tally and enumerate to the point of no message, nothing for the other fellow to catch and examine?

Highet further observes the fragmentation of study by which, "for several decades the majority of scholars have preferred writing small studies . . . of tiny areas . . . of topics obscure and peripheral. Meantime much remains to be done in the great central subjects." He says that "the terrain is getting more and more littered with scattered heaps of bricks which are manufactured and tipped out without any plan whatever, unless it be to cover every inch of exposed ground. As they accumulate, the

task of scholarship becomes not less but more difficult. . . Those looking in from outside see no cathedral arising, and very few buildings have appeared. For brick-making does not produce architects." Highet says that classical scholarship has encouraged the public neglect of which it now complains.

This brings to mind the ancient story of the German savant, ending a long and arduous life of study as the centuries changed. His life work had been study of the verb, "to be." His only regret in looking back, was that he had not achieved more depth by confining his efforts to one of the more obscure subjunctive forms of the same verb.

Scientists may well suspect that the vast expansion in experimental and practical fields has been more potent in displacing the classics than any smallness of perception by the classical scholars. However that may be, Highet's book is good reading for writing and teaching foresters, especially his Chapter 21, "A Century of Scholarship."

There is an immediately compelling reason for trying hard to make our writing attractive and easy to follow. That reason is competition for reading time and for space in our files. When forestry was just getting a start in North America, Schlick had few competitors in our language. But now that forestry has come of age commercially in the past couple of decades, we find ourselves buried by publications of every form and type, so that one of the real problems is to discard the material not pertinent to our interest, and to keep track of what has been done.

It is not suggested that a large number of foresters are writing badly—quite the contrary is true in this one man's view. However the occasional piece of over-specialized lingo is regrettable since the weary reader may miss a voluable point. It is the job of the writer to sort out the important from the trivial and make attractive something of value, remembering that the reader is no captive, but quite free to use his own time to his own taste and interest. Such writing is difficult to do, for a number of interesting reasons, so that the art of writing may be harder than the counting, tabulating, and graphing. But if the job is done with grace as well as "content," there is a chance that someone will pause to read it.

HERMAN WORK
Consulting forester,
Staunton, Virginia

STUDENTS RECEIVE HOMELITE AWARDS. A. Gruettner, district manager of the Homelite Division of Textron, Inc., Detroit, recently presented the annual Homelite Awards to the outstanding junior students in forestry and in forest products at Michigan State University. The Homelie Award is a gift of $250 to each student for the purpose of furthering his education in the field of forestry or forest products.

In the picture, Mr. Gruettner, extreme left, is shown making the award presentations to David A. Young, forestry junior, and David L. Gerwitz, forest products junior, while looking on at the right is William C. Randel, assistant professor of forest products, Michigan State University. The outstanding students to be given the annual awards are selected by the University staff on the basis of high scholastic achievement and participation in student activities.

Reviews

The Community of Living Things in Forest and Woodland

By Stephen Collins. 196 pp. Illus. Creative Educational Society, Mankato, Minn. 1956. $6.95.

This book is one of a series edited by E. S. Ress and sponsored by the National Audubon Society. It consists essentially of 85 pages of outstanding photographs, each with an accompanying page of text. Approximately one-third of these photographs are by the author while the remainder have been expertly chosen from a variety of sources, primarily the National Audubon Society and the U. S. Forest Service. They present a nationwide panorama. As C. E. Mohr so aptly remarks in his forward, "In this book [Collins's] well-chosen pictures and text make the woodlands come to life." Its nontechnical and instructive approach makes it particularly suitable to the teen-ager, but it will prove delightful to young and old alike.

The reader is vividly and succinctly introduced to forest types, forest succession, the lesser forest vegetation, tree growth and development, and floral and faunal interelationships; but perhaps most important, he is made aware of man's dependence on the forest. Topics range from mangrove forests to soil profiles, from mountain lions to rotting logs, and from charcoal kilns to hog-nosed snakes and to controlled burning. About half the plates are directly related to wildlife. The stress on forest conservation is tempered with the concept of wise multiple use. Thus, the book is a well-rounded lesson in forest ecology, encompassing all the pertinent forms of life from man to the simplest fungus.

In the light of this book's educational intent it is perhaps undesirable that a few of the plant and animal names that the author uses could be misleading. It would be advisable to explain, for example, that Douglas-fir is not a fir and that Spanish moss is not a moss.

Most spring flowers are classed by the author as short-day plants and the summer flowers are regarded as long-day plants. Such a classification, however, does not depend upon whether a plant flowers before or after the summer solstice. Many plants, moreover, are totally indifferent to day length in their flowering habits. No conclusions regarding photoperiodic requirements can be drawn simply from a plant's season of flowering.

The author's claim that nationwide annual timber growth is in excess of the annual harvest is misleading since this is only the case for total volume, but is not so on a board foot basis. Over-all growth-cut comparisons are complicated by many factors and have little significance by themselves. His conviction that the future of the nation's wood supply depends upon the adoption by the small forest-landowner of sustained yield cutting practices is an over simplification.

It should also be mentioned that the bat is extolled as being a harmless creature while actually in the Southwest and elsewhere it is becoming an ever-increasing menace as a carrier of rabies.

The wealth of faultless information presented on forest and wildlife lore overshadows by far the few errors and oversights in proofreading which were encountered. The book has amply fulfilled its purpose and I can well recommend it as a valuable adjunct to any young person's library.

ARTHUR H. WESTING
Yale School of Forestry

California Rangeland, an Historico-Ecological Study of the Range Resource of California

By L. T. Burcham. Division of Forestry, Department of Natural Resources, Sacramento, Calif. 261 pp. Illus. 1957.

This work represents an excellent compendium of over 11⅓ pages of bibliographic listings relevant to the historical background of California ranges and their present problems. It is interesting reading, particularly for the person who appreciates the historical background of present-day problems. As an historical account it is definitely above average in readability, being enhanced by interesting quotes from some of the early records and by the author's interpretations of the historical record.

The book is well illustrated, in part by the author's own pen-and-ink sketches and line drawings. It represents the culmination of 20 years of field observation by the author, supplementing his extensive search for recorded facts relevant to the original character of California ranges and the factors contributing to their present condition.

The author presents a good resumé of the published literature on the plant geography of California. From the title I was expecting to read a reappraisal, backed by the author's 20 years' experience, of the ecological information which is available elsewhere in the literature. I was disappointed to find that this was not done. If my appraisal of the book is correct, perhaps it merely indicates that ecological study and interpretation is one important segment of research which may now move ahead more effectively in California because this background has been drawn together by Dr. Burcham.

The author does recognize the need for additional research when he says "While the average level of success . . . [in range improvement projects] . . . is highly encouraging, . . . the frequency of poor results underscores the fact that there still is much basic information that must be developed and applied. . ." While this statement is pointed at range improvement it does imply the need for further study of the ecology of California ranges.

In spite of the above criticism I commend this book to any southwestern or California forester who is interested in the historical background of the range industry, in some of the historical reasons for present range conditions, and in a bird's-eye view of the plant geography of the state.

For those residents of other areas who may be contemplating travel in California, in the southwestern states, or in Mexico, I would definitely commend the book because of the perspective it will provide. In fact, it would be a handy reference to take along on such a trip. It would more than double the enjoyment and information one could acquire while traveling through this interesting country. The plant lists and resumé of plant geography, both in California and in Old Mexico, would provide a good starting point for those unfamiliar with the vegetation of these regions.

The book is organized under ten major headings: From a discussion of "Major Factors Favoring a Range Livestock Industry" in Mexico, the author proceeds to a discussion of "The Prelude in Mexico." Here he draws heavily on historical accounts of the early explorers and Spanish priests and presents a resumé of the plant geography of Mexico adapted from A. S. Leopold, 1950. He then goes back into old Spanish records in an attempt to clarify the characteristics of "The Spanish Livestock" which formed the base for the early development of the range livestock industry in southwestern United States and California. He discusses "California's Range Resource" under the subheadings: "Physiographic," "Climatic," "The Soils," "The Major Plant Types;" and then presents his interpretation of "The Pristine Ranges of California." This review also includes some consideration of the early wildlife populations. For this section, he has drawn heavily on original accounts, many of them in Spanish.

He divides the "California Rangeland" into seven major "kinds of range" from glassland to forest and develops some reasonably logical grazing capacity estimates of the pristine range in terms both of the original Spanish stock and of present-day domestic cattle.

The author proceeds from this point to a discussion of "The Range Today" in which he shows a total animal unit month capacity of 5.59 million in comparison to an estimated pristine capacity of 18.06 million. After he traces the important events in the development of both the cattle and sheep industries, he then discusses "The Impact of Man and his Grazing Animals on the Range Resource." Against a backdrop of the discussion of climatic effects he considers "Replacement of the Native Vegetation, Rates of Stocking the Range, Improvement in Breeds of Livestock," "Nutritional Deficiencies in the Forage, Land Ownership and Land Use Philosophy, Changes in Land Use," and finally "Changes Within the Livestock Industry" as they relate to the influence of use on the range resource of the state.

In his section on "Reversing the Trend," the author discusses some of the range practices currently being used to improve the forage resource. In this section he emphasizes the importance of adequate resource inventories as a basis for "Reversing the Trend" and lists some of the advantages and uses of "Soil-Vegetation Surveys" in this connection.

He concludes with a brief chapter on "The Range Livestock Industry in the State's Economy." Dr. Burcham sees an encouraging outlook during the next ten- to twenty-year period for the California rancher who is able to increase his efficiency of operation and make use of new research findings.

CHARLES E. POULTON
Associate professor of range management, Oregon State College

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Conservation Education in American Colleges

By Charles E. Lively and Jack J. Preiss. 267 pp. Illus. Ronald Press, New York. 1957. $5.

This volume represents the findings of a conservation education survey covering 1,116 colleges and universities of the United States. All data were collected during the calendar years 1954 and 1955 by means of questionnaires to administrators and their staff members teaching conservation in these institutions, a study of their catalog offerings in the conservation field, and a number of visits by the authors of the report to sample schools to check the actual operation of their conservation education programs. The project was initiated and financially supported by the Conservation Foundation, Inc., an organization established to conduct research and to educate concerning the earth's natural resources. The report is divided into three well organized sections with Part I covering the theoretical and historical backgrounds of the conservation movement, Part II dealing with the survey findings, and Part III with its summary and implications.

This report is not only pertinent but extremely important. Coming at a time when the threat of an atomic global war is a frightening reality with its tremendous potential for the vast destruction of many natural resources, its emphasis that the conservation of natural resources is not a teaching problem alone but a general social process which affects the well-being of everyone is a sobering thought. Its premise that good conservation practices, once established, are not self-perpetuating but depend upon the continued support of a well

informed people places a great obligation upon education whether it concerns the user of a specific resource or the broad understandings needed by the public-at-large for the intelligent support of the vitally necessary program. The latter is far from a reality. Most of the 626 conservation teachers queried by the authors of the report felt that the populations of their areas did not have a clear concept of conservation.

When the conservation teachers were asked to rate such common approaches to conservation education as general and historical information, concepts and principles, skills and techniques of management, and economic, political, and social philosophy, the results showed clearly that their opinions were oriented toward concepts and principles as the major frame of reference—a significant trend in conservation education thinking. At the present, the aspects of conservation most likely to be taught are soils, minerals, water, forests, and wildlife in the order given. The aspects least likely to be offered are recreation, range management, and oceanography. That the recreational aspect is not a likely offering is surprising since the greatest number of direct users of the outdoors now are people seeking some form of recreation.

Since the economic and social impacts of conservation upon our culture are so great, there is a growing belief on the part of many educational thinkers that its concepts and principles should become a part of general education. Before this ideal can be reached, the report indicates that a number of things must be done: (1) there must be a clarification and more precise definition of the concept of conservation, (2) a positive approach must take precedence over a negative one, (3) an action program must be set up that will stimulate participant interest, (4) an integrated conservation education program must be developed at every level whether in the classroom or through the efforts of professional conservationists in interpreting their problems to the users of their products, and (5) that educational administrators must be made aware of their responsibilities in implementing an integrated program.

In many respects, this publication is one of the most important to reach professional conservationists in years. Since getting their programs into efficient operation depends, in the long run, upon the informed cooperation of a resource-using public, they should be greatly interested in its findings. It opens the way to a better understanding of our educational obligations in developing an intelligently informed and properly motivated citizenry.

JOHN F. LEWIS
State Teachers College, California, Pa.

Publications of Interest

The Report of the Chief of the Forest Service, 1956, a 32-page summary of the work of the Forest Service, U. S. Department of Agriculture, for the year 1956, together with summarized information on the many uses made of national forest resources is available for 25c from the Superintendent of Documents, Government Printing Office, Washington 25, D. C.

Natural Regeneration of Loblolly Pine in the South Atlantic Coastal Plain, U. S. Department of Agriculture, Forest Service, Production Research Report No. 13, 78 pp., is a complete, documented report on experimental efforts to reproduce loblolly pine. In this research publication Karl F. Wenger and Kenneth B. Trousdell of the Southeastern Forest Experiment Station emphasize seed production, seedbed preparation, and release from hardwoods. Much of the work was done on the Bigwoods Experimental Forest in cooperation with the Camp Manufacturing Company, Franklin, Va. The pamphlet, which sells for 30 cents, should be of particular interest to students who wish to find in one place a complete account of how to reproduce the valuable species. Literature cited includes 109 titles.

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Western logging with International equipment is the theme of a new 12-page booklet recently released by International Harvester. The booklet is devoted to the versatility of the TD-18 and TD-24 International crawler tractors and their adaptation to western logging conditions.

A 12-page logging booklet entitled *Eastern and Southern Logging* shows how the TD-6, TD-9, and TD-14 crawlers are used on logging operations throughout the eastern and southern territories in the United States.

Also available is the 16-page booklet, *From Stump to Mill on Pulpwood Logging,* which pictures and describes logging operations in pulpwood stands throughout the country, featuring the use of TD-6, TD-9, and TD-14 International crawler tractors.

These booklets can be obtained by writing International Harvester Company, 180 North Michigan Avenue, Chicago 1, Ill., or any International Harvester distributor.

Current Literature

Compiled by MARTHA MEELIG, *Librarian, State University College of Forestry at Syracuse University*

Range Management Section Compiled by Division of Bibliography, Library, U. S. Department of Agriculture

General

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Bases for Accrediting Schools of Forestry

Approved by the Council of the Society of American Foresters on November 10, 1957

General Principles

In order to be considered for accreditation, a Department, School, Division, or College of Forestry must meet the following general requirements in addition to the specific criteria described in the following grading system. These general principles are as follows:

(a) Accreditation by a regional accrediting association of the whole educational institution within which the School, Department, Division, or College functions;

(b) Adequate instruction in biological sciences, physical sciences, social sciences, humanities, and engineering to provide the necessary basis for professional training in forestry;

(c) A faculty of at least five men in the Department, School, Division, or College of Forestry, trained in forestry and teaching an adequate curriculum in professional forestry which must include the areas of silviculture, protection, management, economics, and utilization; plus the equivalent of at least one additional man teaching courses within this curriculum and designed specifically for foresters;

(d) The Forestry College, Department, Division, or School must have offered a program of instruction leading to a bachelor's or master's degree in the professional field for at least five years before being considered for accreditation.

The above principles will form the main basis for accreditation, and will be given dominant weight by the Committee for the Advancement of Forestry Education in the evaluation of any forestry school.

In addition, the following accrediting procedures will provide a numerical score for each of eight main categories. This grading system is intended as a guide to the Committee and, in part, as a quantitative basis for accreditation. The numerical scores are used only as a set of indices, to indicate those elements of an institution which are unusually weak or strong.

The final recommendation of the Committee for the Advancement of Forestry Education to the Council of the Society of American Foresters is based upon a qualitative analysis of all pertinent factors, including the judgment of a visiting committee based on a careful on-the-ground review of the institution in question.

Summary of Bases and Weights

Base	Weight
I. Institutional status of forestry	8
II. Faculty—size and duties	18
III. Faculty—qualifications	20
IV. Supporting departments	12
V. Financial support for forestry	14
VI. Facilities	10
VII. Field instruction	13
VIII. History of school	5

Details of Grading System

I. Institutional Status of Forestry — 8

It is the belief of the Committee for the Advancement of Forestry Education that, to reach its highest development, professional forestry education requires such an atmosphere as is provided by an institution of true university caliber. An institution of this type provides strong departments in the basic sciences and in the broad cultural subjects as well as professional training in several fields. In such an institution forestry is not likely to be entered into lightly. The Committee considers that even though a forestry school bears an affiliated relationship to a university-type institution, the advantages still apply if the two are located on the same campus.

Base	Class			Weight
Status of Forestry	Number of colleges, schools, or equivalent in the institution in addition to forestry[1]			
	4 or more	*3*	*2*	*1*
A. Head of forestry reports to administrative or educational head of institution	8	6	3	0
B. Head of forestry reports to next lower level of administration	7	5	2	0
C. Head of forestry reports to third rank of administration	4	2	0	0
D. Forestry a part of another curriculum; *e.g.*, horticulture	0	0	0	0

II. Forestry Faculty—size and duties — 18

A faculty member, for the purposes of this accrediting plan, is one who teaches professional courses in the forestry curriculum and designed specifically for foresters.

Base	Weight
A. Number of faculty	
8 or more men	5
7 men	3
6 men	1

B. Average teaching load of faculty

1. Credit hours per semester

Base	Weight
7 or less	5
8	4
9	3
10 or 11	2
12 or 13	1
Greater than 13	0

[1]The colleges, schools, or equivalent must represent broad fields such as engineering, letters and science, architecture, agriculture, etc.

Credit hours as stated in the school catalog will be used. Two-thirds credit will be given for lectures or laboratory periods repeated during a given semester by the same instructor. Thus a course listed as consisting of two lectures and one laboratory will be valued at three credit hours. If the same instructor repeats each lecture once and has four laboratory sections, the calculation is as follows: Lectures $2 + 2/3 \times 2 = 3\text{-}1/3$; Laboratories $1 + 2/3 \times 3 = 3$. Total credit hours = 6-1/3.

Credit hours for graduate courses will carry 1½ times the value of undergraduate courses. Therefore if an instructor, in addition to the foregoing has two 2-unit graduate seminars the total credit hours are: $6\text{-}1/3 + (1\frac{1}{2} \times 4) = 12\text{-}1/3$ credit hours.

To calculate the average credit hours per semester, the total credit hours offered for an academic year as determined above will be divided by two to derive the average number of credit hours offered per semester. The result will be divided by the number of full-time faculty members engaged in teaching. With a staff of 11 full-time teachers offering 132 credit hours of work during the academic year, the calculation is as follows:

$$\frac{132}{2 \times 11} = 6 \text{ credit hours, average per semester}$$

2. Student credit hours per semester

Base	Weight
Less than 200	4
200-224	3
225-249	2
250-299	1
300 or more	0

To obtain student credit hours, the credit hours as listed in the catalog will be multiplied by the number of students registered for each course. For professional courses on the graduate level multiply student credit hours by two. Assuming an instructor with two 3-unit undergraduate courses, one with 35 students, the other with 28 students; and two 2-unit graduate seminars, one with 10 students, the other with 8 students: $(3 \times 35) + (3 \times 28) + [(2 \times 10) + 2 \times 8] \times 2 = 261$ student credit hours.

To determine the average number of student credit hours per semester, the total number of student credit hours offered during each semester will be divided by the number of instructors actually engaged in teaching for that semester. The averages for the two semesters will now be added and divided by two to obtain the average student credit hours per semester. Assume 5 instructors with a student credit hour load of 1489 during the fall semester, and 7 instructors with a student credit hour load of 1341 during the spring semester; the calculation is as follows:

$$\left(\frac{1489}{5} + \frac{1341}{7}\right) \div 2 = 245$$

student credit hours, average per semester.

C. Percentage of time devoted to professional development; *e.g.*, research, study, travel, extra-curricular professional work, sabbatical leave. The unit head will determine the percentage for each staff member and show the average for the staff.

The Committee believes that, in applying the standards below, if a faculty member is teaching three or more 3-unit courses he should be considered as having no time available for professional development during that term or semester. If employed on an 11-months' basis and with a teaching load as indicated above for two semesters, the time available would be 1/11 or 9 percent.

Base	Weight
1. 35 percent or more of time	4
2. 30 percent to 34 percent of time	3
3. 20 percent to 29 percent of time	2
4. 10 percent to 19 percent of time	1
5. Less than 10 percent of time	0

III. Qualifications of Forestry Faculty (average of staff) 20

A. Study beyond the baccalaureate degree

Base	Weight
Doctor of philosophy, doctor of forestry, or other doctorate appropriate for teachers of forestry	5
Three or more years of study, no degree	3
Two years of study or master's degree	2
One year of study, no degree	1
No formal study	0

B. Professional practice (other than teaching), calendar years

Base	Weight
10 years or more	6
5-10 years	5
2-5 years	3
Less than 2 years	0

C. Teaching experience, academic years

Base	Weight
10 years or more	6
5-10 years	5
2-5 years	3
Less than 2 years	0

D. Activity as authors (average of staff) within the past five years. The standards below are predicated upon the theory that in a professional field a faculty all of whose members have done a modest amount of writing is much stronger than a faculty with one or two prolific writers.

Base	Weight
1. One or more books	3
2. Two or more bulletins	3
3. One professional article per year	3
4 One professional article every two years	2
5. One semi-professional or popular article per year	1
6. Less than above	0

IV. Adequacy of Supporting Departments 12

Faculty members in those departments offering courses, other than forestry, required in the forestry curriculum, exclusive of military sciences, physical education, mechanical drawing, and surveying. Analysis will be made by departments represented rather than by

individuals actually teaching courses in which forestry majors are registered.

A. Departments offering majors with excellent instruction in physical, biological, or social sciences, humanities, or engineering (if the instruction in any or all departments is less than excellent, the rating will be reduced accordingly).

Base	Weight
4 or more	9
3	6
2	3
1	1

B. Qualifications of faculty in supporting departments

Base	Weight
50 percent or more have doctorate	3
25-50 percent have doctorate	2
Less than 25 percent have doctorate	1

V. Financial Support for Forestry 14

A. Budget for administration

Budget adequate for needs of school	4
Budget barely adequate	2
Budget inadequate	0

B. Salary scale for faculty

All salary rates stated below are actual salaries received on an 11 months' work and 1 month vacation basis at a 1956 level. For those institutions with salaries on a 9 months' basis, the salaries should be multiplied by 11/9 to convert to an 11 months' basis. Other salary structures will be calculated in a similar manner.

Head	Professor	Associate Professor	Assistant Professor	Instructor	Weight
$13,500	$12,000	$9,000	$7,000	$6,000	8
12,500	11,000	8,400	6,600	5,700	7
11,500	9,900	7,800	6,200	5,400	6
10,500	8,800	7,300	5,900	5,000	5
9,500	7,800	6,700	5,600	4,600	3
8,500	6,900	6,100	5,300	4,300	2
8,000	6,000	5,500	5,000	4,000	1
Less than (7)					0

To compute the average rating of faculty, find the "rating" for the salary of each faculty member in the table above, and compute the average of all ratings. Round off to the nearest whole number.

C. Fringe benefits

Retirement contributions, medical and related insurance, group life insurance, or other benefits to which the institution contributes beyond the salary of the faculty members.

Category	Weight
Excellent	2
Good	1
Poor	0

VI. Facilities 10

To be determined through inspection by a visiting committee. A check list follows this section.

A. Buildings

1. Adequate space for classes in professional subjects.
2. Adequate office space for faculty, suitable for both study and consultation.
3. Adequate office space for clerical staff.
4. Classroom and office space with a reasonable degree of concentration so as to provide a desirable professional atmosphere.
5. Sufficient space for classes in professional subjects to be held between the hours of 7 a.m. and 6 p.m., so as to offer the least possible interference with the many worth-while extra-curricular activities of the parent institution (*e.g.*, the forestry club and the forestry honor societies).
6. Adequate storage space and service rooms (*e.g.*, rooms for preparation of instructional materials).

B. Library.

1. Central location (accessibility).
2. Available to students throughout the day.
3. Adequate reading room space.
4. All essential items available (as determined from check list).
5. Sufficient copies of references available.
6. Regular budget for annual accessions.
7. Serviceable catalog of accessions available to students.
8. Professional staff.

C. Laboratories

In rating, take into account the specific field for which the laboratory is used and whether more than one class is scheduled for the same space.

Factors:

1. Equipment and facilities adequate for subject matter.
2. Adequate space for number of students using laboratories at any session of class.
3. Light (natural and artificial) and ventilation adequate.
4. Adequate storage space and service rooms for laboratories.

Equipment

Check list to be used by visiting committee

Equipment items	Adequate	Barely Adequate	Inadequate
Classrooms (forestry subjects)			
Space			
Lighting			
Ventilation			
Laboratories (forestry subjects)			
Space			
Lighting			
Ventilation			
Equipment			
Library (forestry items)			
Location			
Reading room space			
Stack space			

Availability of facilities
Adequacy of library items
Budget for annual accessions
Catalog
Professional staff

Faculty offices
Space
Suitability for study and consultation
Concentration in bldg.

Clerical office
Space
Ventilation and lighting
Location with reference to faculty offices

Evaluation:	Weight
All factors adequate	10
Half of factors adequate—half barely adequate	7
All factors barely adequate	5
Half of factors barely adequate—half inadequate	2
All factors inadequate	0

VII. Field Instruction 13

To be based on questionnaire and interview with head of department.

A. Field laboratory

Factors:

1. Not less than 1,000 acres of managed forest available for use by the school of forestry.
2. Field laboratory used in undergraduate instruction.
3. Good representation of forest types and age classes.
4. Good representation of soil types and sites.
5. Equipment adequate for field instruction.
6. Accessible fabrication plants available for class use.
7. Adequate housing for students—both classroom and dwelling.
8. Less than 15 students per instructor.

Base	Weight
First two factors plus any three other factors favorable	5
First two factors plus any two other factors favorable	4
First two factors plus any one other factor favorable	3
First two factors alone favorable	2
Less than above	0

B. Field instruction—suitably allocated to silviculture, mensuration, forest engineering, dendrology, forest management, protection, utilization, and related subjects.

Base	Weight
20 or more credit hours	8
19 credit hours	7
17-18 credit hours	6
15-16 credit hours	5
13-14 credit hours	4
11-12 credit hours	3
9-10 credit hours	2
6-8 credit hours	1
Less than 6 credit hours	0

NOTE: One credit hour will be granted for each week of summer camp, or for field instruction averaging one-half day per week during an academic semester.

VIII. History of School 5

Base	Weight
A. Length of time with 4-year or graduate curriculum	
1. 15 years or more	3
2. 10-14 years	2
3. 5-9 years	1
B. Alumni	
Rating of alumni competence by employers	
Good	2
Average	1
Poor	0

Society Affairs

Officers and Council
1958-1959

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U. S. Forest Service
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Portland 8, Ore.

HENRY J. VAUX
School of Forestry
University of California
Berkeley 4, Calif.

Report of Council Meeting

A meeting of the Council was held March 17 and 18, 1958 in the executive office of the Society in Washington, D. C.

All members were present as follows: President George A. Garratt, Vice President Henry J. Malsberger, B. E. Allen, P. A. Briegleb, Donald E. Clark, C. A. Connaughton, Kenneth P. Davis, M. K. Goddard, W. D. Hagenstein, J. H. Stone, and Henry J. Vaux; together with Henry Clepper, executive secretary.

Appointment of Executive Secretary

Article VI, Section 2 of the Constitution contains the following provision:

"The Executive Secretary shall be appointed by the Council which is empowered to enter into contractual relations with him during the period not exceeding two years for which he is appointed."

On motion by Mr. Goddard, seconded by Dr. Vaux, the Council voted unanimously to reappoint Henry Clepper as Executive Secretary for the two-year period 1958-1959.

1958 Budget

Miss L. A. Warren, Society business manager, reported on the income and expense of Society operations for the fiscal year 1957 (December 1-November 30), and submitted a proposed budget for 1958. After certain salary revisions to adjust them with current costs of living, the Council approved the budget for 1958, as indicated in Table 1.

Endowment Fund

As provided in Bylaw 67, the Society has a Permanent Fund. Only the income from this fund may be expended, for such special purposes as the Council may direct. The fund now amounts to $5,370.

Several members of the Council have proposed that additional amounts be appropriated to build up this fund or a similar endowment fund.

Accordingly, on motion by Mr. Hagenstein, seconded by Mr. Briegleb, the Council unanimously voted to authorize the President to appoint a committee of three to investigate the possibility of setting up a permanent endowment fund, and to report with their recommendations at the next Council meeting.

Financing Annual Meetings

Miss Warren reported on the costs and methods of financing annual meetings.

It has been customary on occasion for the host Section, or group of host Sections, to provide favors, social entertainment, and other amenities. Such activities, while pleasant and invariably appreciated by the members and their ladies, are not necessary and not expected at every meeting, and the host Sections need not consider them obligatory. On the other hand, payment for favors and social entertainment cannot be paid from the funds budgeted for an annual meeting and obtained from registration fees. To clarify this matter the Council took action as follows.

On motion by Mr. Briegleb, seconded by Mr. Allen, the Council voted unanimously that annual meetings will

be organized and financed in accordance with a plan and budget prepared by the Executive Secretary; and that this budget will not include social entertainment, favors, and decorations which shall be optional but which if provided shall be obligations of the host Section or Sections.

Education Study

Last fall the Society was notified that a grant of $39,500 would be available from the Old Dominion Foundation to support a study of education in forestry and related fields of natural resources management. The purpose and objectives of the study were explained in the annual report of President DeWitt Nelson, published in the JOURNAL OF FORESTRY for January 1958, page 49.

Upon authorization by the Council a Supervisory Committee has been established to oversee the project. The members are:

Chairman, Henry J. Vaux, School of Forestry, University of California, Berkeley.

Richard E. McArdle, U. S. Forest Service, Washington, D. C.

Bernard L. Orell, Weyerhaeuser Sales Company, Saint Paul, Minn.

Hardy L. Shirley, College of Forestry, Syracuse, N. Y.

Secretary, Henry Clepper, Society of American Foresters, Washington, D. C.

George A. Garratt, School of Forestry, Yale University, New Haven, Conn., *ex officio.*

The Committee's first duty is to select a director and such additional consultants and collaborators as may be needed. Periodic reports on the progress of the study will appear in the JOURNAL.

Committee for Advancement of Forestry Education

At the meeting of the Council held November 10, 1957 in Syracuse, N. Y., the members voted unanimously to accept the recommendation of the Committee for the Advancement of Forestry Education that at least two members of the Committee, together with the Executive Secretary, constitute the visiting committee to any institution under examination for accrediting purposes.

The Executive Secretary pointed out that this requirement, in certain cases, would result in unduly high, and unnecessary travel expense.

Accordingly, on motion by Mr. Briegleb, seconded by Mr. Vaux, the Council voted unanimously that the intent of the foregoing action is to be considered as permissive and not as obligatory, at the discretion of the Committee for the Advancement of Forestry Education.

TABLE 1.—INCOME AND EXPENSES FOR 1957 AND BUDGET FOR 1958

	1957	1958
Income		
Dues	$105,991	$111,000
Fees	1,415	1,500
Subscriptions; sales	10,110	9,500
Advertising	32,055	35,000
Miscellaneous income	5,892	2,500
Forestry Terminology	——	1,000
Miscellaneous Society publications	——	400
Forestry Handbook	——	3,000
Interest; dividends	1,878	2,000
Total	$157,341	$165,900
Expense		
JOURNAL OF FORESTRY	$ 46,548	$ 48,400
Editors expense	470	1,200
Salaries, editorial	14,945	18,710
Salary, Executive Secretary	10,825	11,718
Salaries, office	34,672	40,000
Advertising commission	9,110	10,000
Advertising promotion; expense	4,311	4,500
Travel, officers	4,058	4,500
Postage	2,572	3,000
Telephone; telegram	788	800
Rent	6,689	7,308
Multigraphing; mimeograph	641	700
Miscellaneous printing	1,014	1,400
Office supplies	1,048	1,500
General expenses	965	1,200
Depreciation	1,476	1,500
Retirement plan	1,479	1,372
Affiliation dues	160	210
Committee expense	85	100
Division expense	14	100
Grading forestry schools	623	1,000
Council travel	1,878	1,500
Social Security tax	1,121	1,200
Election of officers; fellows	753	——
Equipment maintenance	424	500
Referenda	459	——
Proceedings	——	500
Miscellaneous	527	500
Total	$147,655	$163,418
Net earnings	$ 9,685	$ 2,482

Graduate Training for Research Careers

The Research Committee (R. H. Westveld, chairman) of the Council of Forestry School Executives has as one of its objectives the development of increased contractual arrangements between the U. S. Department of Agriculture and the forestry schools. The purpose is to strengthen their research and graduate training programs.

As a means of advancing this desirable objective, the Council, on a motion by Dr. Vaux, seconded by Mr. Goddard, unanimously adopted the following policy:

"The Council of the Society of American Foresters recognizes the need for a considerably larger and continuing supply of well-trained scientists to conduct research in forestry and related fields. The effectiveness of graduate training for research careers can be greatly strengthened by coordination of such instruction with broad and active programs of forestry research. Accordingly, the Council endorses in principle more widespread use of contractual arrangements between the United States Department of Agriculture and the forestry schools and other appropriate units of research as a means of strengthening the research and graduate training programs of those institutions."

For the purpose of implementing this policy, Dr. Vaux made the following motion, seconded by Mr. Hagenstein, which was unanimously approved:

"The Council of the Society of American Foresters authorizes the President to designate a representative of the Society to present the foregoing resolution to the appropriate Congressional committee if and when hearings on relevant legislation are held."

Schlich Memorial Award

The Sir William Schlich memorial medal is awarded periodically by the Society for distinguished service to forestry. The medal honors the famous forester who was professor of forestry at Oxford University. Following his death in 1925, English speaking foresters throughout the world contributed funds to a Foundation to commemorate his contributions to forestry.

In the United States the Society of American Foresters was designated by the Empire Forestry Association as custodian of the award. The Council first authorized presentation of the medal in 1935, to President Franklin D. Roosevelt. It has been awarded eight times since then, the latest being to Samuel T. Dana in 1956.

On motion by Mr. Stone, seconded by Mr. Goddard, the Council voted unanimously to make another award in 1958 on the occasion of the Society's annual dinner in Salt Lake City, October 1. As is customary the recipient's name will not be made public until the presentation.

Biological Research Awards

In 1955 an anonymous donor established a fund of $10,000 the proceeds of which are used to make periodic awards for outstanding achievement in biological research leading to the advancement of forestry. Four awards have been made, each consisting of a cash payment and a specially designed plaque in the enlarged shape of the Society's emblem.

Recipients in 1956 were Leo A. Isaac and P. C. Wakeley. In 1957 they were C. Syrach Larsen and Harold J. Lutz.

In presenting two awards annually in 1956 and 1957, the Council does not consider such action as a precedent; in fact, during some years the award may not be made at all, and in most years only one award will be authorized.

The Council committee for these awards consists of P. A. Briegleb, chairman; K. P. Davis, and M. K. Goddard. On the recommendation of this committee, and on motion by Dr. Davis, seconded by Mr. Briegleb, the Council voted unanimously to make another award on the occasion of the Society's annual dinner in Salt Lake City on October 1, 1958. As is customary, the recipient's name will not be made public until the presentation.

Wilderness Preservation

During the past three years various proposals, together with specific bills, have been made to the Congress that legislation be enacted to establish a national wilderness preservation system and a National Wilderness Preservation Council.

Following considerable discussion of the proposals and after examination of the latest Senate bill, the Council unanimously adopted the following policy, on motion by Dr. Davis, seconded by Dr. Vaux.

"The Council of the Society of American Foresters reafirms its support of the concept of multiple use of forest and other wild lands, as approved by referendum of the membership in 1947. The Council believes that wilderness is a proper part of a program of multiple use for public lands. Furthermore, the Council believes that the determination of areas suitable for wilderness and the boundaries thereof are responsibilities and functions of the personnel charged with administration of these lands."

Society Publications

Arthur B. Meyer, staff editor of Society publications, made a report on

SCHOOL BOX SCORE
1958 MEMBERSHIP

	Student Applications Received		
	May 1958	Total 1957	Total 1958
Alabama Polytechnic Institute	0	19	22
University of California	1	30	56
Colorado State University	0	19	7
Duke University	0	13	2
University of Florida	0	6	14
University of Georgia	3	86	39
University of Idaho	1	19	11
Iowa State College	3	35	14
Louisiana Polytechnic Institute	0	18	4
Louisiana State University	3	41	4
University of Maine	3	31	21
University of Massachusetts	2	10	4
Mich. Coll. of Mining & Tech.	0	29	3
Michigan State University	2	24	15
University of Michigan	2	14	12
University of Minnesota	2	28	25
University of Missouri	0	62	7
Montana State University	1	45	10
State University of New York	0	25	12
North Carolina State College	0	36	1
Oregon State College	4	29	24
Pennsylvania State University	5	32	21
Purdue University	0	18	17
Utah State University	0	5	24
University of Washington	4	27	23
West Virginia University	0	19	15
Yale University	0	7	3
Totals	36	727	410

SECTION BOX SCORE
1958 MEMBERSHIP

	Applications Received[1]		
	May 1958	Total 1957	Total 1958
Allegheny	7	68	41
Appalachian	0	71	11
Central Rocky Mountain	0	24	7
Central States	0	30	17
Columbia River	9	55	38
Gulf States	7	84	22
Inland Empire	2	21	13
Intermountain	1	6	31
Kentucky-Tennessee	0	8	3
New England	6	62	34
New York	3	37	18
Northern California	2	39	10
Northern Rocky Mountain	3	49	16
Ozark	1	92	15
Puget Sound	9	61	38
Southeastern	3	132	82
Southern California	0	3	0
Southwestern	0	7	0
Upper-Mississippi Valley	8	69	44
Washington	0	10	1
Wisconsin-Michigan	7	84	44
Totals	68	1,012	485

[1]Students, Junior, Affiliate, Associate (Initial) grades only.

editorial matters, summarized as follows:

Forestry Terminology. The book is at the bindery and should be available for distribution by the end of March, according to the printer. This third edition contains 102 pages. It will sell for $3.50, postpaid.

Forestry Handbook. Committees, consisting of 2 men for each section—usually one of original committee and one new man—are now in process of studying the need and nature of revisions. They are to report by April 15. Following that, consultation will be held with the publisher regarding revision.

Forestry as a Profession. Since September 1956, 9,500 copies have been printed. A new printing is now in process.

American Forestry: The First Sixty Years. This book is to be published in connection with 60th annual meeting in 1960. It will have 19 chapters and an appendix. The Council recommended that consideration be given to including a chapter dealing with forest recreation.

JOURNAL OF FORESTRY. Two special issues are scheduled. "What's New in Wood Utilization," in August; "Progress in Tree Improvement," in November. A special issue or symposium planned for early publication will deal with the effect of silvicides on the environment. A total of 125 articles and 70 notes was submitted during the past 12 months. The Council was urged to encourage members to submit material to the JOURNAL.

Forest Science

During 1958, while S. H. Spurr is absent from the University of Michigan on a National Science Foundation fellowship, Kenneth P. Davis is acting as editor of *Forest Science.*

Dr. Davis made a report on *Forest Science.* The quarterly, which has been in existence since 1955, has about 1,200 subscribers, and with editorial assistance provided by F. H. Eyre and the business staff of the Society has been published profitably with net earnings of $6,131 through 1957.

On the recommendation of Dr. Spurr and Dr. Davis, and on motion by Mr. Clark, seconded by Mr. Briegleb, the Council voted unanimously (1) that the tenure of members on the editorial advisory board be three years instead of two; and (2) that the Board of Editors be appointed for three years, the terms of office to be staggered.

Appointments to the Board of Editors and to the editorial advisory board

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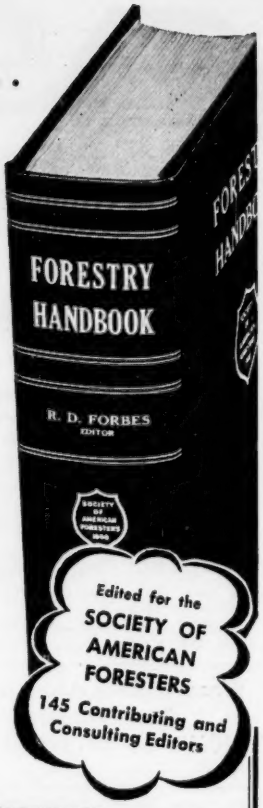

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will be made by the President on recommendation of the Board of Editors.

The Council thanked Dr. Spurr and Dr. Davis for the high quality of their services to *Forest Science*.

Forestry History Committee, Forest History Foundation

A Committee on the History of Forestry has been in existence, though not continuously, since 1923. It has performed numerous services to the profession, such as the compilation of the book *Fifty Years of Forestry in the U.S.A.*, published by the Society on the occasion of the 50th anniversary in 1950.

With the establishment of a paid editorial and publications staff in the Society executive office, and with the formation of the Forest History Foundation, fewer assignments having to do with historical matters have been handled by the Committee.

Moreover, the Society unfortunately has not been able to appropriate funds out of the budget for Committee projects.

Hence, in view of the fact that the Committee does not now have any specific assignments, and as none is contemplated in the near future, it has been proposed that the Committee be discontinued until such time as projects requiring the service of a Committee on History are authorized.

Accordingly, on motion by Mr. Hagenstein, seconded by Mr. Stone, the Council voted unanimously to discontinue the Committee on History with thanks to Chairman E. N. Munns and the other members; and to designate Frank H. Kaufert, president of the Forest History Foundation, as the Society's official representative to the Foundation's Board of Directors.

As a modest contribution to the activities of the Foundation, the Council voted, on motion by Dr. Davis, seconded by Mr. Hagenstein, to contribute $50 in 1958 and $50 in 1959 toward the work of the Foundation.

Annual Meetings

Under the Society's system of rotating annual meetings in the several regions of the United States, the 1962 meeting is due to be held in the South.

Accordingly, on a motion by Mr. Allen, seconded by Mr. Briegleb, the Council voted unanimously to schedule the 1962 meeting in Atlanta, Ga. during October. The specific dates will be announced later.

Forthcoming annual meetings are now scheduled as follows:

1958—September 29, 30, and October 1. Salt Lake City, Utah.

1959—November 15-18. San Francisco, Calif.

1960—November 13-16. Washington, D. C. (Sixtieth anniversary meeting).

1961—October (specific dates to be determined later). Minneapolis, Minn. (Joint meeting with the Canadian Institute of Forestry).

Society Affairs Session 1958 Annual Meeting

The regular Society Affairs session will be held during the annual meeting on Tuesday afternoon, September 30. It will be of 1½ hours duration.

Following this session there will be a brief intermission, then 2 hours of discussion of two policy matters of national interest. Unless subsequently changed, the two issues will be the proposed national wilderness preservation system and aerial spraying of woodland.

Committee on Safety

The Committee on Safety has been in existence since 1951. The chairman from its inception has been Seth Jackson of the U. S. Forest Service, Washington, D. C. Annual reports of the Committee's activities have been regularly reported in the Society Affairs sessions of annual meetings and reported in the JOURNAL OF FORESTRY.

Inasmuch as the Committee's activities are largely concerned with education in safety, it has been proposed that the Committee be assigned to the Division of Education, and that it make reports to that body rather than the Council.

Accordingly, on motion by Mr. Goddard, seconded by Mr. Clark, the Council voted unanimously to assign the Committee on Safety to the Division of Education. This action has the approval of the Division's officers.

Natural Resources and the Biological Sciences

On motion by Mr. Clark, seconded by Mr. Goddard, the Council unanimously approved the following statement:

"In view of the very strong attention which is being directed in these times to engineering sciences as related to the future defense and welfare of the United States and other free nations of the world, it appears timely and important that attention be directed as well to the basic significance of natural resources as a foundation for such defense and welfare. Therefore, it would be well for the Society of

American Foresters to collaborate with other biological science societies, particularly at this time, in calling attention to the place of natural resources and the sciences relating to their management and development."

In further explanation of this resolution, the Executive Secretary pointed out that the Society of American Foresters is now, and long has been, actively affiliated with several national bodies with strong representation in the biological sciences. Among these organizations are the American Association for the Advancement of Science; the Division of Biology and Agriculture, National Research Council; the American Institute of Biological Sciences; and the Natural Resources Council of America.

Greeley Memorial Committee

At the Council meeting held February 19-21, 1956, a committee was appointed to consider a suitable memorial to the late William B. Greeley. Named to the committee were E. F. Heacox, chairman; J. H. Stone and G. A. Garratt.

In view of the fact that the forest industry nursery at Nisqually, Wash. was renamed the Col. W. B. Greeley Forest Nursery with memorial services in which the Columbia River and Puget Sound Sections participated, and in view of the William B. Greeley Memorial laboratory at Yale University, now in process of development, the committee believes that there is no need for further action on its part at this time.

Accordingly, on motion by Mr. Stone, seconded by Mr. Goddard, the Council voted unanimously to discharge the aforementioned Committee.

Exhibits of Members' Art

At the Syracuse meeting in November 1957 a suggestion was submitted to the Council that provision be made at annual meetings for the exhibition of works of art of members, including photography.

On motion by Mr. Hagenstein, seconded by Mr. Clark, the Council unanimously voted that any members who wish to exhibit works of art may do so on the same basis as educational exhibits.

Thus, the Society cannot pay for exhibit space, for transportation of works of art, or for police protection which is customarily essential in guarding such exhibits; and the Committee on Exhibits cannot assume responsibility for the custody, display, and return of such objects other than in the manner in which educational exhibits are handled.

Miscellaneous

Council Members B. E. Allen cordially invited the Council to hold its 1959 spring meeting at the Palmetto Bluff Club, the property of the Union Bag-Camp Paper Corporation.

The Council's Column

The Society and Forestry Education

From its beginning, the Society has had a deep interest in forestry education, an interest that has broadened over the years. *Forest Education* by Graves and Guise, published in 1932, was a milestone of reporting in its time. The presently planned study, financed by a grant from the Old

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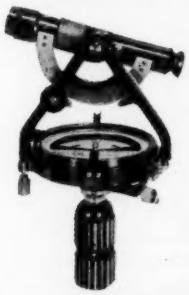

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Dominion Foundation, is most timely and must appraise a more complex situation.

Establishment and maintenance of forestry school accreditation is a major project and accomplishment of the Society. This work has defined and done much to raise the level of undergraduate training, at which it has been primarily aimed. But the increasing importance of graduate work and its close relationships to undergraduate instruction has necessitated a widening concern. One evidence of this was the change in name a few years ago to the Committee for the Advancement of Forestry Education with an enlarged charter of interest. Another is direct liaison and participation with regional agencies in accreditation work (see Wilm's report in the February JOURNAL, page 163). The bounds of what constitutes desirable forestry education are increasingly difficult to define.

Accreditation does not, however, embrace all forestry education problems in which the Society has an interest. Here's one of them. A large number of nonaccredited institutions offer varying amounts and kinds of forestry work (see the December 1957 JOURNAL, page 919). By far the majority do not intend to develop degree work but for various reasons give forestry courses. Some are more or less mixed with preforestry curriculums but this training is basically distinct as it derives from the availability of good liberal arts rather than forestry courses.

Nonaccredited and listed schools are left pretty much in outer darkness by the Society except as they may aspire to accreditation. But considerable numbers of men enter forestry jobs from such schools. Many also transfer for both undergraduate and graduate work to accredited schools who struggle with course evaluations as best they can —as I well know from having worked with many such cases. One gets into all sorts of problems; how should one regard more general courses in or near the forestry area labelled as protection, general forestry, conservation, and the like? What about professional courses like dendrology, silviculture, management, or mensuration? Should they be taken at face value or what? If the institution is accredited as a whole, college level credit is usually transferable and rapidly depletes any general electives pot there may be if such courses are not matched directly to required courses. It is often a delicate matter *not* to transfer credit and yet the best educational interest of the student may stand in the way. Some nonaccredited institutions do first rate work on some courses. In other cases, one is in doubt. How do you know?

This matter is brought up, not to air college transcript evaluation problems as such, but because behind it there is a matter of real concern to the Society; of facilitating movement of qualified men to accredited schools. May it not become desirable to develop mechanics for establishing some sort of "par" by courses rather than by curriculums? Many of the principles of curriculum accreditation apply to its component courses. I realize the difficulties, but they are faced by accredited schools now on an individual basis. Might not some Society interest in these institutions give a better and more consistent basis for evaluation?

Another large and more crucial educational problem is where and how schools are going to get and keep qualified staff. The national over-all shortage and competitive situation of college teachers is well publicized and forestry schools are just a part of this

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larger problem. The pressure for the Ph.D. degree in hiring is well known and understandable. The trend is strongly towards specialization, and the way Ph.D. programs are handled increasingly reflects it.

Forestry is an applied field and, when you specialize, you tend to work away from rather than toward its center. Most Ph.D. candidates want to be specialists; in forestry they want to be soils experts, geneticists, physiologists, entomologists, pathologists, economists, and the like. It is hard to frame Ph.D. programs in the more applied and central fields of primary utilization, mensuration, silviculture, and management —and also to interest qualified men in them. Only a part of the background needed for effective instruction in these areas can be acquired through graduate work anyway. We do not develop enough such men and get them into teaching.

Even if there were enough Ph.D.'s to go around, which is certainly unlikely, the net result may be a weakening of good instruction in the forestry mainline. There is a tendency to take prowess in our mainline for granted. There are large technical needs here too. The only general answers I have are to recognize that a problem exists, to keep perspective, and not to sell forestry short.

The continued prosperity of the Society and the profession depend on good forestry education. All members are concerned whether immediately affected or not. Individually and collectively, and in many ways, their interest and positive action is needed.

KENNETH P. DAVIS

Coming Events

Forest Products Research Society

The twelfth annual meeting of the Forest Products Research Society will be held June 22-27 at Madison, Wis.

N. E. Tree Improvement Conference

The Northeast Tree Improvement Conference will be held at Beltsville, Md., August 21-22.

Society of American Foresters

The Hotel Utah, Salt Lake City, will be headquarters for the Society's 58th annual meeting scheduled for September 28-October 1.

American Forestry Association

The 83rd annual meeting of the American Forestry Association will be held in Tucson, Ariz., October 27-30, 1958. Headquarters will be the Pioneer Hotel. Meeting theme: "Water, Forests, and People."

Wisconsin-Michigan Winter Meeting

"Using Public Relations to Promote Forestry" was the theme of the semi-annual meeting of the Wisconsin-Michigan Section at Milwaukee, Wis., where more than 150 members and guests attended the banquet and meetings held March 14 and 15. Promoting forestry rather than promoting forestry organizations was stressed throughout the program which was keynoted by W. A. Kluender, agriculture and resource director, Chicago and Northwestern Railway Co. John W. Macon, section chairman and forester for Consolidated Water Power & Paper Co., Rhinelander, Wis., presided over the meeting.

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The aggressive public relations needed to sell forestry to the public, the owners of woodlands and marginal crop lands, sportsmen and recreation people, industry management, and public officials were explained by a capable panel composed of George Banzhaf, consulting forester; John Dale, farmer conservationist; Ernest L. George, chief forester for Kimberly-Clark Corp.; Terrill D. Stevens, head of the Forestry Department at Michigan State University; and Casey Westell, research forester of the American Box Board Co. Robert Kidera, professor of journalism at Marquette University, spoke on the motivating factors governing the choice of future careers by students and stated that, surprisingly, most boys decide on a career or at least on a particular family of careers at the early age of 12 through 14 years. Forestry has many features that can appeal to the boy of that age and foresters could attract more students into this field if more effort was made to contact young boys. The banquet speaker was George Sievers, industrial psychologist, who delivered a lively address on leadership.

Host for the successful winter section meeting was the Milwaukee Chapter. H. O. Nixon, forester with the U. S. Forest Service, is chairman of the Chapter. J. M. Kimmel is vice chairman and H. N. Putnam is secretary-treasurer. R. J. Costley of the U. S. Forest Service acted as banquet toastmaster and many other chapter members contributed greatly to the excellent program arrangements.

During the business meeting the following section officers were elected to take office July 1: Donald Zettle, forester with the Michigan Conservation Department, Marquette, chairman; Harold A. Svensen, U. S. Forest Service, Milwaukee, vice chairman; and Donald O. Prielipp, Kimberly-Clark Corp., Kingsford, Mich., secretary-treasurer. Site of the summer section meeting will be in the northwestern part of Wisconsin sometime in September.

Membership Applications and Advancements

Proposals for admission, advancement, and reinstatements received in the Society office during the month of March are listed below.

Action on the eligibility of those proposed for membership as listed below will be taken by the Council as of June 1958. Communications from voting members regarding the membership eligibility of these persons should be received in the Society office prior to that date.

Allegheny Section

Student Grade

PENNSYLVANIA STATE UNIVERSITY

Frank, J. M. — Jacobs, R. D.
Hobaugh, M. E. — Snyder, G. W.
Stewart, M. G.

Junior Grade

Kormanik, P. P., Graduate Asst., School of Forestry, Pa. State, University Park, Pa.; Pa. State, B.S.F., 1957.

Miller, R. L., Forester & Owner of Pine Top Woodland Improvement Service, Salisbury, Md., W. Va. Univ., B.S.F., 1950.

Students Eligible for Automatic Advancement

WEST VIRGINIA UNIVERSITY
Fitzgerald, D. W.

Appalachian Section

Junior Grade

Looney, E. W., Dist. Forester, N. C. Dept. of Cons. & Dev., Elizabeth City, N. C. (Reinstatement).

Students Eligible for Automatic Advancement

NORTH CAROLINA STATE UNIVERSITY
De Coste, J. H.
Member Grade

Albrecht, F. J., Forest Landowner—Mgr., Sullivan Island, S. C. (Junior 1951).

Collicott, L. W., Dist. Forester, Int'l Paper Co., New Bern, N. C. (Junior 1951).

Cooper, C. F., Graduate Student, Nat'l Science Foundation Fellow, Duke Univ., Durham, N. C. (Junior 1951).

Dalton, C. B., Asst. Forester, Clemson College, Clemson, S. C., Univ. of Mich., B.S.F., 1954 (Junior 1954).

Fox, M. F., Forester, Riegel Paper Co., Lake Waccamaw, N. C. (Junior 1951).

Holland, J. C., Forester, Int'l Paper Co., Castle Hayne, N. C. (Junior 1951).

Hudson, H. H., Forester, W. Va. Pulp & Paper Co., Manteo, N. C. (Junior 1951).

Keller, W. M., Forester, N. C. Ext. Serv., Raleigh, N. C. (Junior 1951).

McVicker, G. W., Eng. & Dev. Forester, Gair Woodlands Corp., Savannah, Ga.; W. Va. Univ., B.S.F., 1950. (Junior 1954).

Morris, W. E., Forester, Int'l Paper Co., Wananish, N. C. (Junior 1951).

Peterson, D. W., Asst. Ranger, USFS, N. C. Nat'l Forests, Murphy, N. C. (Junior 1951).

Rainer, Y. W., Area Forester, Greensboro, N. C. (Junior 1951).

Ray, P. L., Unit Forester, Int'l Paper Co., Georgetown, S. C. (Junior 1951).

Rhyne, T. S., Dist. Forester, N. C. Div. of Forestry, Whiteville, N. C. (Junior 1951).

Safley, J. W., Forester, Planter's Mfg. Co., New Bern, N. C. (Junior 1951).

Sheppard, W., Dist. Forester, W. Va. Pulp & Paper Co., Georgetown, S. C. (Junior 1951).

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Shilling, R. E., Forester, Int'l Paper Co., Elizabethtown, N. C. (Junior 1951).
Trew, I. F., Forester, W. Va., Pulp & Paper Co., Manteo, N. C. (Junior 1951).
Willoughby, C. C., Log Buyer, Coastal Lumber Co., Weldon, N. C. (Junior 1951).

Affiliate Grade

Smith, H. G., Service Forester, Va. Div. of Forestry, Salem, Va.

Central Rocky Mountain Section

Junior Grade

Students Eligible for Automatic Advancement

COLORADO STATE UNIVERSITY

Brown, E. V. Rate, H. A.

Central States Section

Member Grade

Krauch, H. C., Dist. Farm Forester, Shoals, Ind. (Junior 1949).

Columbia River Section

Student Grade

OREGON STATE COLLEGE

Ewart, R. K. Martin, P. K.
Ready, S. R. Tollefson, J. O.

Junior Grade

Manock, E. R., Cons. Asst., Ore. State Board of Forestry, Salem, Ore., Ore. State College. (Reinstatement).
Anderson, J. M., Forester, Bur. of Land Mgmt., Roseburg, Ore.; Univ. of Wash., B.S.F., 1957.
Martin, L. J., Surveyor, Wilford N. Haines, Drain, Ore.; Univ. of Idaho, B.S.F., 1951.
Sadler, R. R., Forester, Bur. of Land Mgmt., Coos Bay, Ore.; Mich. College of Mining & Tech., B.S.F., 1957.
Sheppard, G. H., Forester, Bur. of Land Mgmt., Medford, Ore.; Mich. College of Mining & Tech., B.S.F., 1957.

Member Grade

Bauer, T. J., Foreman, Int'l Paper Co., Reedsport, Ore. (Junior 1951).
Catalanotto, L. G., Tbr. Mgmt. Asst., USFS, Fort Klamath, Ore. (Junior 1951).
Cook, F. T., Adm. Asst., BLM, Coos Bay, Ore. (Junior 1951).
Count, V. J., Woods Foreman, Al Firchau Logging Co., Reedsport, Ore. (Junior 1951).
Hall, J. E., Oregon State Tax Comm., Klamath Falls, Ore. (Junior 1951).
Posekanv, R. L., Tbr. & Plywood Salesman, Int'l Paper Co., Reedsport, Ore. (Junior 1951).
Sapousek, O. F. A., Tbr. Mgmt. Asst., Umpqua Nat'l Forest, Tiller, Ore. (Junior 1951).
Sorgenfrei, S. J., Tbr. Mgmt. Asst., Umpqua Nat'l Forest, Roseburg, Ore. (Junior 1951).

Affiliate Grade

Lowell, L. L., Tbr. Consultant, Pacific Plywood Corp., Dillard, Ore.

Gulf States Section

Student Grade

LOUISIANA STATE UNIVERSITY

Byrd, R. R. Germany, R. A.
Robinson, W. M.

Junior Grade

Bridges, G. G., Forester, Southern Pine Lbr. Co., Pineland, Tex.; Univ. of Florida, B.S.F., 1957.
Watts, T. R., Dist. Forester, Masonite Corp., Laurel, Miss.; La. State Univ., B.S.F., 1951.

Member Grade

Bryant, R. L., Asst. Forester, McNeese State College, Lake Charles, La.; La. State, B.S.F., 1953; M. S. (Game Mgmt.), 1954.
Baumann, O. H., Asst. Dist. Forester, Int'l. Paper Co., Brandon, Miss. (Junior 1951).
Dunford, H. V., 1404 Maple St., Winnfield, La. (Junior 1951).
Kuprionis, J., Assoc. Prof. of Silviculture, L.P.I., Ruston, La.; Mich. State, M.F., 1950.
McDonald, D. E., Hercules Powder Co., Hattiesburg, Miss. (Junior 1951).
Oliver, W. D., Dist. Supervisor, Int'l. Paper Co., Carthage, Tex. (Junior 1951).
Rhodes, J. W., Forester, Int'l. Paper Co., Alexandria, La. (Junior 1951).

Affiliate Grade

Bustin, W. E., Forester, Bienville Nat'l. Forest, Forest, Miss.
Chapman, G. E., Jr. Forester, USFS, Meadville, Miss.

Inland Empire Section

Student Grade

UNIVERSITY OF IDAHO

Dutton, L. A.

Junior Grade

Foltz, W. G., Graduate Student, Univ. of Idaho, Moscow, Idaho, M.F. (Junior 1957).

Intermountain Section

Affiliate Grade

Reese, B. W., USFS, Ashton, Idaho.
Sutherland, C. D., Dist. Forester, Boise Payette Lbr. Co., Council, Idaho. (Reinstatement).

Kentucky-Tennessee Section

Member Grade

Mason, R. R., Forest Ent. & Path., Hiwassee Land Co., Calhoun, Tenn., Univ. of Mich., B.S.F., 1952; M.F., 1956.

New England Section

Student Grade

UNIVERSITY OF MAINE

Dubov, B. J. Lindsay, J. J.
Hardy, S. S.

UNIVERSITY OF MASSACHUSETTS

Jenkins, M. E. McFarlin, M. J.

Junior Grade

Perkins, S. H., Secretary, Forester and Mgr. of Woodland Serv., Connwood Inc., Rockfall, Conn. (Affiliate 1953).

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Member Grade

Cameron, G. P., County Forester, Brattleboro, Vt. (Junior 1951).

Affiliate Grade

Leighton, R. S., County Forester, Univ. of New Hampshire, Rochester, N. H.,

New York Section

Junior Grade

Kuhn, C. W., Private Consulting Forester, Cattaraugus, N. Y.; State Univ. of N. Y., B.S.F., 1942.

Lewis, S. E., USFS, Paul Smith, N. Y.; Pa. State, B.S., 1956; M.F., 1957.

Member Grade

Engel, J. E., Cambridge, Md. (Junior 1951).

Fry, D. H., Instructor, N. Y. State Ranger School, Wanekena, N. Y. (Junior 1951).

Fry, H. J., Horsehead, N. Y. (Junior 1951).

Fulton, P. A., Forestry Dept., Consolidated Paper Co., Pembroke, Ont., Canada (Junior 1951).

Hagar, R. K., Forest Appraiser, N. Y. State Board of Equalization & Assessment, Saranac Lake, N. Y. (Junior 1951).

Miller, R. M., R. D. No. 2, Jamestown, N. Y. (Junior 1951).

Vredenburgh, M. A., Fly Creek, N. Y. (Junior 1951).

Affiliate Grade

Munro, W. E. H., Assoc. Forester, Canadian Forestry Assoc. of Ont., Toronto, Canada.

Northern California Section

Student Grade

UNIVERSITY OF CALIFORNIA

Dresser, H. E.

Junior Grade

Dittman, J. R., Forester, Winton Lbr. Co., Martell, Calif., Ore. State, B.S.F., 1950.

Northern Rocky Mountain Section

Student Grade

MONTANA STATE UNIVERSITY

Keppner, A. P.

Junior Grade

Lockhart, R. E., Forester, USFS, Libby, Mont.; Mont. State, B.S.F., 1940.

Sencabaugh, J. R., Forester, USFS, Libby, Mont.; Univ. of Mass., B.S.F., 1957.

Ozark Section

Affiliate Grade

Brown, P. M., Lt. U. S. Army, Sulphur, Okla.

Puget Sound Section

Student Grade

UNIVERSITY OF WASHINGTON

Nunan, J. H. Rolph, L. C.
Palmer, C. H. Smith, C. L.

Junior Grade

Bowers, J. F., Forester, USFS, Anchorage, Alaska; Colo. State, B.S.F., 1949.

Niemi, W. O., Forester, Wash. State Dept. of Resources, Olympia, Wash.; Mich. College of Mining and Tech., B.S.F., 1957.

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Carlson, W. D., Forester, Wash. Dept. of Resources, Olympia, Wash.; Mich. College of Mining & Tech., B.S.F., 1957.

Affiliate Grade

Erickson, T. R., Sales Compliances Forester, Dept. of Natural Resources, Beaver, Wash.

Plaskett, J. M., Log Scaler, Crown Zellerbach Corp., Port Angeles, Wash.

Southeastern Section

Student Grade

UNIVERSITY OF GEORGIA

Atkinson, R. T. Mauldin, A. T.
Pinkle, J. J.

Member Grade

Arnbal, A. K., Unit Forester, Int'l. Paper Co., Richmond Hill, Ga.; Univ. of Ga., B.S.F., 1954.

Dick, D. L., P. O. Box 207, Palm Beach, Fla. (Junior 1950).

Greene, J. T., Asst. Prof. Research Genetics, Univ. of Ga., B.S.F., 1956.

Hinkle, R. J., Container Corp. of America, Fernanda Beach, Fla.; West Va. Univ., B.S.F., 1950.

Mordecai, C. R., Supt. Conserv. Dept., Union Bag-Camp Paper Co., Savannah, Ga.; Univ. of Ga., B.S.F., 1951.

Smith, J. H., Asst. to Woods-Mgr., Scott Paper Co., Mobile, Ala.; A.P.I., B.S.F., 1949.

Williams, H. W., Asst. Dist. Forester, Ga. Forestry Comm., Waycross, Ga.; Univ. of Ga., B.S.F., 1949.

Upper Mississippi Valley Section

Student Grade

IOWA STATE COLLEGE

Arendts, C. L. Klinoff, R. H.
Leary, R. A.

UNIVERSITY OF MINNESOTA

Clark, R. F. Haugen, E. F.

Junior Grade

Buchanan, D. W., Asst. Ranger, USFS, Tofte, Minn.; Iowa State College, B.S.F., 1954.

Christianson, E. M., Dist. Forester, Northern Pacific Railway Co., St. Paul, Minn.; Univ. of Minn., B.S.F., 1950. (Reinstatement).

Crosby, C. E., Asst. Dist. Ranger, USFS, Isabella, Minn. (Reinstatement).

Keenan, A. V., Land Appraiser, USFS, Grand Rapids, Minn.; State Univ. of N. Y., B.S.F., 1949.

Simon, H. F., Forester, USFS, Faribault, Minn.; Iowa State College, B.S.F., 1950.

Washington Section

Member Grade

Brownworth, F. S., USFS, Alexandria, Va. (Junior 1951).

McArdle, R. C., Central Intelligence Agency, Alexandria, Va. (Junior 1951).

Wisconsin-Michigan Section

Student Grade

MICHIGAN STATE UNIVERSITY

Hull, R. D. Kuehne, M. J.

UNIVERSITY OF MICHIGAN

Eckart, E. E. Flory, R. C.

Junior Grade

Hein, C. E. H., Forester, Calumet & Heela, Inc., Calumet, Mich. (Affiliate 1955).

Potter, W. J., Forester, Mich. Dept. of Cons., Baldwin, Mich.; Univ. of Mich., B.S.F., 1952.

Student Eligible for Automatic Advancement

Henschel, E. G.

Affiliate Grade

Salminen, W. A., Asst. Foreman, USFS, Skandia, Mich.

Sandstrom, S. G., Forester, Keweenah Land Assoc., Marquette, Mich.

Zollner, J. A., Asst. Dist. Forester, Mich. Dept. of Cons., Manistique, Mich. (Reinstatement).

No Section

Junior Grade

Freese, L. S., U. S. Army, FPO, San Francisco, Calif.; Mich. College of Mining & Tech., B.S.F., 1956.

Nelson, G. N., Ens., U. S. Navy, Patuxent River, Md. (Reinstatement).

Corresponding Grade

Atay, A. H., ICA, Istanbul, Turkey.

Han, Y. C., ICA, Taipei, Taiwan.

Suprichakorn, T., Assoc. Dean School of Forestry, Kasetsart Univ., Thailand.

Yang, Y. K., ICA, Chai-yi, Taiwan.

Yokoyama, M., Director, Shizuoka Pref. Forest Expt. Sta.; Shizuoka, Japan.

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Forestry News

North American Wildlife Conference Held

The 23rd North American Wildlife Conference was held March 3-5 in St. Louis, Mo. This international conservation conference is sponsored by The Wildlife Management Institute, Washington, D. C. Among the nearly 1,100 persons who registered and attended were natural resources administrators and leaders, fish and game technicians, outdoor writers, and sportsmen from 47 states, Canada, Alaska, Mexico, Hawaii, and Puerto Rico.

The theme of the conference was "Conservation in an Expanding Economy." About 60 papers were presented during the three general and six technical sessions that made up the program. All conference presentations, the names of registrants, and the recorded discussion from the floor will be published in the printed Transactions of the North American Wildlife Conference. The record of the meeting will be available from the Institute upon publication.

Nearly 600 persons attended the annual Conference banquet at which time Dr. E. R. Kalmbach, former director of the wildlife research laboratory of the U. S. Fish and Wildlife Service in Denver, Colo., was awarded the Aldo Leopold Medal for distinguished service to wildlife conservation.

The 24th North American Wildlife Conference will be held March 2-4, 1959, at the Statler Hotel in New York City, according to the Wildlife Management Institute.

Pulp and Paper Day Celebrated

April 15 was marked by the southern pulp and paper industry as the first Pulp and Paper Day in order to focus attention on the economic importance of the industry to the South. Activities, in which a majority of the 67 primary pulp and paper mills in the 11 southern states took part, included tours of mills and woods, banquets, and civic club meetings.

Northwest Forest Tree Seed Committee Meets

The Northwest Forest Tree Seed Committee, composed of representatives of industry, universities, federal, state and local organizations in the Pacific Northwest and British Columbia recently held its semi-annual meeting at Corvallis, Ore. Organized in July of 1953, the committee, affiliated with the Western Forestry and Conservation Association, concerns itself with both research and practical problems on tree seed.

In the research session, chairmanned by Dr. George Allen, University of British Columbia, reports are given on ways of determining cone maturity; weight changes in seed as affected by date of collecting; after-ripening of early harvested cones, using damp storage; and seed sampling for testing of germination.

Research projects proposed for future emphasis are: cone maturity as indicated by anatomical studies of cone scales, by chemical reactions in the

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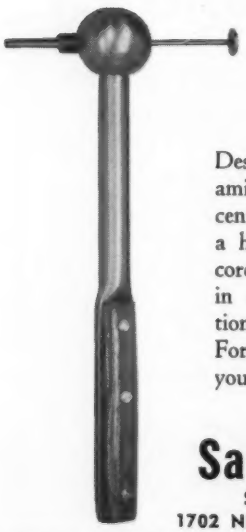

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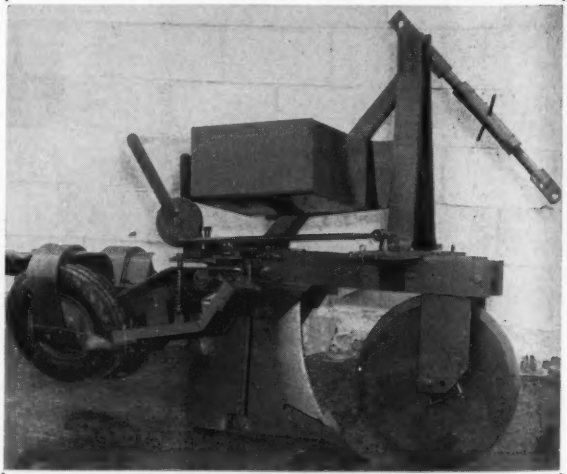

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seed itself, temperature and related factors; seed testing techniques for all species for standardization and special studies on the genus Abies along with storage problems; quality control work to evaluate the effects of various processing procedures; and control of cone and seed insects.

The committee also discussed seed certification and came to the conclusion that there is not enough research information available at this time in the Northwest to recommend certification standards or rules.

Officers elected for the next year were Charles Rindt, U. S. Forest Service, as chairman and Lee Hunt, U. S. Bureau of Land Management, secretary.

Visitors to National Park Areas Set New Record in 1957

Travel to the 180 areas administered by the National Park Service broke all records in 1957 and for the second successive year ran ahead of the estimates on which the long-range Mission 66 program for park improvement is based, according to Secretary of the Interior Fred A. Seaton.

Visits totaled 59,300,000, an 8 percent increase over the 55,000,000 reported in the preceding year and 4,000,000 more than the Mission 66 estimates two years ago had anticipated for 1957, he said.

National Park Service Director Conrad L. Wirth pointed out that the upward trend was continuing at the beginning of 1958 with the total January visitation of 1,745,251 up 9½ percent from January of 1957. The 29 national parks led for the month with a 19 percent increase.

Date of Northeastern Forest Tree Improvement Conference Set

The next meeting of the Northeastern Forest Tree Improvement Conference is scheduled for Beltsville, Md., August 21 and 22, 1958. It will be held at the Plant Industry Station of the U. S. Dept. Agriculture. Dormitory facilities are not available at the University of Maryland, but there are excellent motels in the vicinity of Beltsville to provide ample accommodations.

The first morning session will be given over to presentation of technical papers.

In the afternoon there will be a field trip to the Beltsville Experimental Forest to see the forest genetics plantations of the Northeastern Forest Experiment Station. The oldest of these are 18 years old from seed.

There will be a conference dinner on August 21 followed by a picture show as in previous years.

On the morning of August 22 there will be a choice of two tours: to see basic research or appled research.

The program for the ladies and youngsters may include visits to Annapolis, to the Institute of Home Economics at the Agricultural Research Center, to the University of Maryland, and possibly to other points of interest.

Second National Conference on Agricultural Meteorology

The Connecticut Agricultural Experiment Station and the Yale School of Forestry at New Haven will be the site of the Second National Conference on Agricultural Meteorology to be held under the American Meteorological Society's sponsorship on October 22-24 1958. Applications of meteorology and climatology in agronomy, horticulture and forestry will be discussed.

Sessions are planned on the follow-

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ing phases of agricultural meteorology: Climatological Needs of Agriculture; Evapotranspiration and Water Relationships; Statistical Methods; Forecasting for Agricultural Operations; Observations and Instrumentation." However, papers on any phase of agricultural meteorology and climatology will be welcome and additional sessions may be scheduled if necessary.

General Chairman for the meetings is Dr. Paul E. Waggoner, Head of the Department of Soils and Climatology of the Connecticut Agricultural Experiment Station. Program Chairman is A. Vaughn Havens, Associate Professor of Meteorology, College of Agriculture, Rutgers University, New Brunswick, New Jersey. Titles and abstracts of papers should be sent to the Program Chairman at the above address before July 1, 1958.

Interior Department Alaska Fire Losses Heavy in 1957

The 1957 forest and range fire losses for the Department of the Interior lands were considerably heavier than for 1956 and far heavier than the average annual loss for the previous 10 years. The heavy loss was due almost entirely to extraordinarily bad fire conditions in Alaska. Within the continental United States losses were lighter than the average.

The total number of fires was 2,471, or 347 less than the previous year. This represents a 10 percent decrease in number of fires but was 14 fires more than the 10-year average.

The area of federal and Indian lands burned over during the calendar year 1957 was 5,220,070 acres as contrasted to 631,375 acres in 1956 and with the 10-year average of 923,536 acres.

The number of man-caused fires was 1,457 as contrasted to 1,256 in 1956. Lightning fires for the year were 1,014, a decrease from the previous year of 448.

The Bureau of Sport Fisheries and Wildlife reported an excellent year with only 58 fires burning 3,198 acres. This is about half the number of fires as related to the 10-year average and only about seven percent of the 10-year average area burned.

The National Park Service had a most successful year, except for a difficult situation in the Everglades National Park, with only 244 fires reported as contrasted with 364 fires as the average for the past 10 years. The Service reports 16,797 acres burned over as contrasted to the 10-year average of 17,817 acres. The Everglades National Park fire burned 15,220 acres which is 99 percent of the total burn for the entire Service.

Likewise, the Bureau of Indian Affairs had a very good year with only 787 fires burning 40,005 acres as contrasted to the 10-year average of 1,007 fires burning 69,407 acres.

The major emergency existed on public domain lands in the Territory of Alaska. The Bureau of Land Management reported 1,382 fires. Of these, 403 were in Alaska. Of the 5,160,070 acres reported as burned over 4,839,281 acres were in Alaska. The major cause of fires in Alaska during the year was lightning, with 164 fires out of 403 being attributed to that cause.

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sociation from an industry survey made as of 1956 there were 1,025 foresters employed in the 12 states served by the Association.

The area of paper company forest land was nearly 18.5 million acres. The industry planted 222 million seedlings. Company operated nurseries, totalling 17, produced 154 million trees. Some 30 thousand private land owners were given free technical assistance and received 56 million industry-grown seedlings.

Company owned forest land open to hunting and fishing totalled 13.7 million acres, with 940 thousand acres in state game refuges. In addition there were 77 company forest recreation areas.

The paper companies in 1956 made 114 scholarships available, and placed 1,485 youths in industry-sponsored forest camps.

These and other interesting data will soon be available in an attractive booklet which may be obtained from the Southern Pulpwood Conservation Association, 900 Peachtree Street, N. E., Atlanta 9, Ga.

Continental Can Company to Award Scholarships

The Woodlands Department of Continental Can Company, Inc., of Hopewell, Va., has announced the inauguration of a new program of scholarships in forestry. Yearly, scholarships will be awarded to two outstanding high school graduates with one student to be chosen from certain designated counties in central North Carolina, another from Virginia. Each scholarship is for a four year period, dependent upon continuing creditable college work, at the rate of $1,000 per year for a total of $4,000. The students are to select the forestry school of their choice from the schools of North Carolina State College, West Virginia University, and Pennsylvania State University.

St. Regis Fellowship Awarded

St. Regis Paper Company announces the award of its Fellowship in Forestry to William P. Wheeler, member of the forestry teaching staff at Oregon State College, Corvallis. Wheeler, a native of Crosby, Minn., is a graduate of the University of Minnesota with both Bachelor's and Master's degrees in forestry. The Fellowship in Forestry, valued at $1,000 is given for one year.

Mr. Wheeler plans to enter the Graduate School of the State University of New York at Syracuse in

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September to continue his education toward a Doctorate in forestry, with a major in silviculture.

This is the sixth St. Regis Fellowship in Forestry to be awarded to

W. P. WHEELER

degree holders planning to take graduate work in any accredited school of forestry in the United States. Also for the sixth year, St. Regis offers five undergraduate scholarships in forestry.

A. L. Bennett Named to New Post

A. L. Bennett, woodlands manager for Armstrong Forest Co., Johnsonburg, Pa., has been named vice president. He succeeds E. F. O'Hara, who resigned. Bennett is a 1940 forestry graduate of Penn State and has been with Armstrong since that time.

Plantaion Yields Under Industrial Study

Six southern pulp and paper corporations with land holdings ranging from North Carolina to Texas are cooperating with Dr. T. S. Coile, forest land consultant, Durham, N. C., on a research project concerning the growth and yield of plantations of loblolly and slash pines. The project is of three-years duration and is expected to supply much needed information on the growth and yield of plantations of the two species as affected by soil, topography, spacing, rainfall, and site preparation. Anyone interested in this subject or who knows of the location of older plantations or low or high site quality, or plantations that have recorded information on thinnings are invited to contact Dr. Coile.

Forester Heads Equitable Loans Department

The Equitable Life Assurance Society of the United States has promoted R. E. Huff to manager of timber loans, a new position. In making the announcement, Eli Ferguson, second vice president and head of the Society's farm mortgage department, said, "The creation of the new position reflects both the growing size of our timber loan account and our wish to have an experienced forester and timber loan analyst supervise the program."

Huff, a forestry graduate of North Carolina State College, was in the lumber business and served as forest appraiser for the Federal Land Bank of Columbia, S. C., before joining The Equitable in 1952. As reviewing forest appraiser, he has played a key role in the organization and development of the Society's timber loan program. In his new assignment, Mr. Huff will have his headquarters in the Society's home office in New York City.

AFPI Surveys Recreation Uses of Industrial Forests

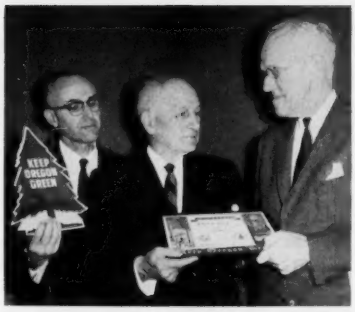
Wide use is made of industrial forest lands for recreation according to a recent survey made by American Forest Products Industries, Inc. The survey, which covered 455 companies, revealed that 42,737,567 acres or 92.4 percent of the total area covered in the survey, are open to hunters in season. Exclusive of game refuges, only 5.8 percent of the area surveyed is closed to hunting. Some 96 percent of the area is open to fishing, including 55,928 miles of lake shore and stream banks.

Sixty-five companies have gone so far as to establish 132 public parks, some of them elaborately equipped with free overnight facilities and services. Five companies have parks open to employees only. Thirty-one companies were planning to open additional parks during 1957—the year in which the survey was completed—and 69 other companies listed plans for such parks in the future. Six companies offer skiing in season, and two of them operate tow lifts.

In a few cases, service charges are made, mostly for fern picking, trapping and camping. The survey shows that 90 companies require permits for major activities, such as berry picking, horseback riding, picnicking, rock hunting, hiking, swimming, camping, winter sports, trapping and fern picking. Seven companies, employ professional recreational planners. Some 3,328 miles of hiking trails are open to the public In a single year—1956—companies included in the survey estimated that 1,533,795 persons used their lands for recreation, including hunting and fishing.

The survey as it pertains to hunting developed these statistics: Thirty one companies employ game management specialists to work with hunters and fishermen to improve the game-fish supply. Some 32,377,567 acres, or 70 percent of the total area survey, are open to all without permit. Some 7,437,864 acres, or 16.1 percent of the total area, are open to all with permits. Some 2,922,107 acres or 6.3 percent of the total, are open with permit to neighbors and special groups. Some 1,987,074 acres are leased to 625 hunting organizations. Some 3,269 hunting camp sites are leased to hunters.

Some 104 companies give special consideration to game in their harvesting operations. Forty-four companies plant game food species.



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Education

Bramble Leaves Penn State for Purdue University

William C. Bramble, acting director of the School of Forestry and head of the Department of Forest Management since 1954 at the Pennsylvania State University, has been appointed head of the Department of Forestry at Purdue University. He succeeds the late E. R. Martell.

Bramble received the B.S. degree in forestry at Penn State in 1929, and the M.F. and Ph.D. at Yale in 1930 and 1932. He was a National Research Council Fellow in Switzerland in 1935.

Appointed to the forestry faculty at Penn State in 1937, he has taught continuously for twenty years except for military service during World War II.

Donald H. Clark Honored by University of Washington

Dr. Donald H. Clark, was named "Honored Alumnus for 1958" by the University of Washington Foresters Alumni Association. Dr. Clark is the eleventh forestry alumnus to receive the annual award. It was presented by Dr. Henry Schmitz, president of the University and a previous winner of the honor.

In honoring Dr. Clark, the forestry alumni cited "his long and successful association with the lumber industry and his special interest in the utilization of northwest hardwoods and reduction of wood wastes." Dr. Clark, a 1917 graduate of the College of Forestry, has been active in various phases of the forest industry for more than 40 years. Since 1953, he has been assistant director of the Institute of Forest Products, a state agency with headquarters on the campus.

WILLIAM C. BRAMBLE

Michigan Tech's Ford Forestry Center Increases Staff

Philip L. Thornton has been appointed research forester at Michigan Tech's Ford Forestry Center, Alberta, Mich., according to a recent announcement by Dr. J. R. Van Pelt, president of the college.

Thornton received his B.S. degree in forestry from New York College of Forestry at Syracuse in 1949 and his master's at the same institution in 1950. From 1951 until his present assignment, Thornton was employed by the Lake States Forest Experiment Station and the Central States Forest Experiment Station. Before that he was employed by the New England Forestry Foundation.

Dr. Eric A. Bourdo, Jr., is director of the Ford Forestry Center.

New York College of Forestry Adds to Staff

Dr. Hardy L. Shirley, dean of the State University of New York College of Forestry at Syracuse University, has announced the appointment to the college faculty recently of Dr. J. J. Hermans, director, Cellulose Research Institute and professor of Cellulose Chemistry.

Dr. Hermans is an internationally-known authority on the chemistry of macromolecular substances. He comes to the United States directly from Europe, where he has been professor of Physical Chemistry and director of the Laboratory for Inorganic and Physical Chemistry at the University of Leiden, at Leiden, The Netherlands.

Also announced was the recent appointment to the college faculty of

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Donald R. Satterlund as instructor in forest influences. Satterlund earned his B.S. degree in forestry from the University of Michigan in 1951. In June 1955, he received his Master of Forestry degree from there and was serving as a research assistant at the time of his new appointment.

Public

Forest Service Plans Drive for Improving Small Woodlands

Ways and means for improving the condition of the nation's 4.5 milllion farm and other small forest properties will be the subject for discussion at a series of regional meetings this fall, the U. S. Department of Agriculture has announced.

Richard E. McCardle, Forest Service chief, has asked regional foresters, in collaboration with state foresters, to call these meetings to consider the problem of forestry on small forest ownerships and possible methods and procedures for achieving better management on these lands. The meetings will be open. All those interested will have a chance to express their views. Farmers, other landowners, and those who deal day-to-day with them and know the problems first-hand, will be invited to take an active part in the regional discussions.

"The meetings will explore whether the framework of existing programs is adequate, whether they need to be modified, whether new approaches are needed, and how responsibilities can best be shared," Mr. McArdle said.

Lloyd R. Olson Transfers to Washington

Lloyd R. Olson, supervisor of the Mt. Hood national forest since 1950, is transferring to the Washington office of the Forest Service as assistant director in the division of fire control. Olson, a native of Snohomish, Washington, received his forestry training at the University of Washington, graduating in 1931. He has been with the Forest Service since 1934 on several national forests in the Pacific Northwest Region; he also has had assignments with the divisions of fire control and state and private forestry in the regional office at Portland.

Jarvi Transfers to North Central Region

Simeri E. Jarvi of San Bernardino, California, has been transferred to the North Central Region of the U. S. Forest Service to head up the Division of State and Private Forestry. In this capacity he will be in charge of Forest Service participation in cooperative tree planting, forest fire prevention and control and other advisory and technical assistance programs carried on jointly with state conservation agencies and private timberland owners.

Jarvi graduated from the School of Forestry at Oregon State College, and has had extensive experience on several national forests, and in forest fire control as well as cooperative forestry programs in Washington, Oregon, and California.

Cron Named Kootenai Supervisor

Robert H. Cron has been appointed supervisor of the Kootenai National Forest, Libby, Montana. Mr. Cron, a graduate of New York State College of Forestry, entered the Forest Service in California in 1938 and has had several national forest assignments the last of which was as assistant supervisor of the Modoc National Forest.

Paul Neff Named Forest Supervisor

Paul E. Neff, logging engineer for the Northern Region, U. S. Forest Service, Missoula, Mont. has been promoted to forest supervisor of the Mount Hood National Forest, Portland, Oregon. Mr. Neff is the son of Philip Neff, long-time logging engineer for the Forest Service. Paul Neff, a graduate of the School of Forestry, Montana State University, Missoula in 1941, served with the 50th Engineers Combat Battalion in the Asiatic-Pacific Theatre after which he received appointment with the U. S. Forest

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Service. He has had assignments on the Colville and Kaniksu national forests and in the regional office as logging engineer, the position vacated by his father just eight years before.

Albert Albertson Retires, Succeeded by Howard Foulger

Albert Albertson, supervisor of the Dixie National Forest at Cedar City, Utah for the past 16 years, retired on March 31 and will be replaced by Howard R. Foulger, assistant chief of Range and Wildlife Management in the Regional Office at Ogden, Utah.

A native of Emery, Utah, Mr. Albertson entered the Forest Service in 1920. After serving as forest ranger and assistant supervisor of the Fishlake National Forest, he was named supervisor of the Dixie National Forest in 1942. Mr. Albertson was given the Silver Beaver award by the Boy Scouts of America in 1952. He is past president of the Utah Chapter of the American Society of Range Management.

Mr. Foulger is a native of Ogden, Utah and a graduate of the College of Forest, Range and Wildlife Management of Utah State University in 1939. He was appointed range examiner on the Caribou National Forest in Idaho in 1942 and subsequently occupied several other national forest posts in Idaho and Utah.

Washington Initiates Intensive Survey

Donald H. Clark, assistant technical director of the Institute of Forest Products, Seattle, Wash., announces that the institute has initiated a forest industry survey of Whatcom and Skagit Counties, Wash. The survey will involve an inventory of forest lands and their potential yield under adequate management, including state, federal, and private holdings, making use of U. S. Forest Service data collected in 1957. The survey will also ascertain the wood requirements of local industries, checked against potential forest yields and will analyze any surplus over present requirements as available for new industries within the counties.

William H. Price, forest consultant, will supervise the project, assisted by Samuel A. Newman, also a consultant.

Should the survey yield tangible results in establishing new forest industries in the counties, and in securing a better wood supply for existing industries, the Institute expects to consider an extension of the survey.

Product & Equipment

Motorola Mobile Radio with Transistorized Power Supply Available

A two-way mobile radio is now available for the first time with a fully transistorized power supply, Motorola has announced.

The first transistor powered radios were placed on the market by Motorola in mid-1957. These were 20-25 watt sets. The new "T-Power" equipment now available includes 60 watt radiophones in the 144-174 MC. band and 50 and 100 watt units in the 25-54 MC. band. Four transistors are used in the 100 watt radio to replace both the vibrator and the dynamotor.

Transistors are characterized by their exceptionally long trouble-free life, providing the user increased reliability and efficiency over extended periods with minimum maintenance.

Further information can be obtained by writing to Motorola Communications & Electronics, Inc., Dept. T, 4501 W. Augusta Blvd., Chicago 51, Ill.

Forestry Employment

S.A.F. members are privileged to insert one 60-word advertisement in this column without charge. Forest industries desiring to employ foresters may insert advertisements at the rate of $4 per column inch. Copy must be received by the end of this month for an advertisement to appear in the issue after next.

Obviously, the Society cannot assume responsibility beyond making it possible for prospective employee and employer to enter into negotiations.

Position Available

Opening available for young assistant or associate professor in forest utilization and technology, beginning September, 1958. Ph.D. necessary, or requirements near fulfillment. Some teaching experience and interest in research desirable. Salary range (9 months basis) $6500 to $7000, depending on qualifications Apply to Dean, College of Forest, Range, and Wildlife Management, Utah State University, Logan, Utah.

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HERE'S a tool that's winning fast acceptance for low-cost forest site preparation. It's a Cat Diesel Tractor equipped with Rome K-G Blade. The D7, owned by the West Virginia Pulp and Paper Co., is clearing a hardwood area near Summerville, S. C. The cut-over area is left until ready to burn, then planted with 700 trees to an acre with an 8′ x 8′ spacing. R. E. Haynes, Woodlands Division Manager, says: "We think it is the best tool we have found—a more effective way of getting the job done in this type of clearing."

This type of clearing is tough work, and the D7 is ruggedly built to stand up under it. For example, the heavy-duty frame and steering clutch case unit is made of fabricated steel. The track shoes, hardened by a special process, outwear ordinary shoes. The oil clutch, an exclusive Caterpillar development, gives up to 1,500 hours without adjustment. And the sturdy 128 flywheel HP engine operates on low-cost fuel without fouling. Because of these and other heavy-duty features, the D7 can deliver more work at lower cost with less down time than any machine in its power range!

For facts and figures about Cat Diesel Tractors on site preparation, see your Caterpillar Dealer. Taken from an actual job study, these facts provide a clear comparison of the effectiveness of different machines and methods on tree and stump shearing, raking and windrowing, chaining, stump treatment and harrowing. Your Caterpillar Dealer will be glad to show them to you. He'll demonstrate, too. Call him today!

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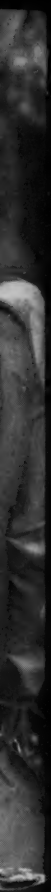
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